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Taking Impressions—*Smith*

EDITORIAL
Care of Children's Teeth

DENTAL HEALTH EDUCATION
Self-Selection Diet—*Davis*
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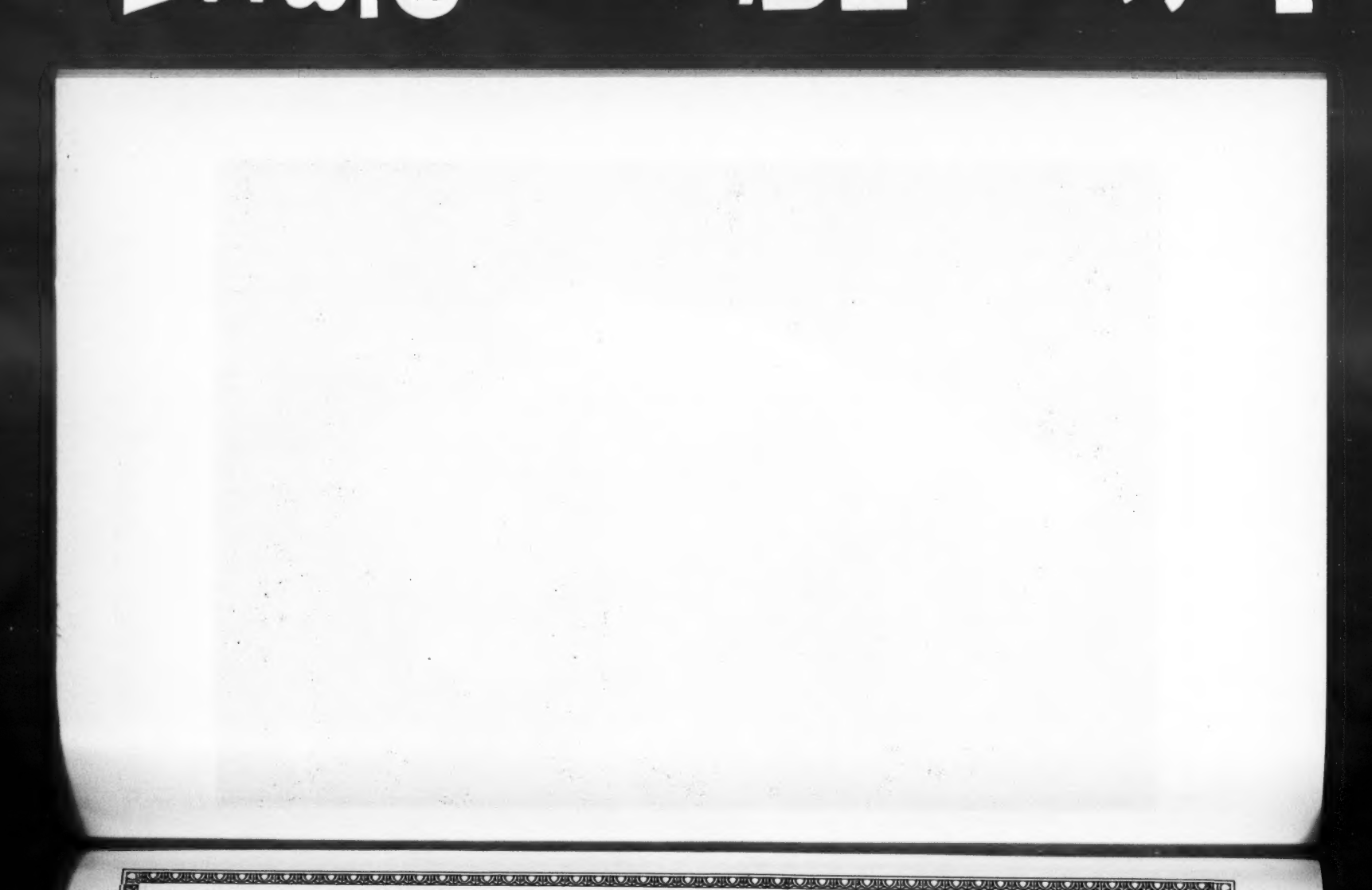

MAURICE WILLIAM, D.D.S., New York City

THE JOURNAL
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Vol. 18 JUNE, 1931 No. 6

Original Communications

A LIVING AMERICAN DENTIST'S EPOCHAL INTELLECTUAL CONTRIBUTION TO WORLD HISTORY*

By WILLIAM J. GIES, New York City

OUR association is an international body devoted to research in dentistry. I am happy to bring to your attention a situation of great international significance. Research has been required to reveal its import. When fully understood, the important matter about to be indicated will redound to the credit of dentistry, because it represents an eminent intellectual achievement by a dentist who for a quarter of a century has been engaged primarily in the practice of his profession. This presentation is made entirely on my own initiative. I have felt that dentists should receive the first formal direct statement regarding the matter, and that this is the most suitable time and place for the announcement. The dentist who is directly concerned has been persuaded to give me complete freedom to follow my own judgment in the statement about to be made. During my description of the situation, his name will be withheld. Until I present his name, he will be designated as "our colleague."

I shall begin in what may seem to be a peculiar way and in an unexpected field of human interest. In 1919 and 1920, our colleague wrote a book entitled "The Social Interpretation of History: A Refutation of the Marxian Economic Interpretation of History." I said a moment ago that our colleague's name would be temporarily withheld. I am confident that I have not revealed his personality by mentioning the title of the important book he wrote. Although his name is given conventionally in the book as its author and the book is not out of print, dentists have completely overlooked the work, and its author's modesty has helped to maintain general ig-

*This statement represents the author's recollection of an extemporaneous presentation at the Ninth General Meeting of the International Association for Dental Research, Memphis, Tenn., March 21-22, 1931.

norance regarding it. I have already stated that our colleague wrote this book in 1919 and 1920. At that time, he had been an active member of the Socialist party for about twenty-five years. His book represented both a heartache and a headache as he reflected on social conditions after the World War. His book set forth the conviction that the marxian economic interpretation of history and the destructive influences arising therefrom, as illustrated in Russia, were unsound in fact and fatal in effect. He presented, instead, a social philosophy founded on historic realities. At its base, as a permanent force in the evolution of civilization, he placed the inevitable struggle for subsistence—the law of self-preservation. Upon this, he grounded the needs of the consumer as contrasted with the privileges of the producer. Class cooperation instead of class warfare, considerations of humanity instead of preferences for violence, friendship instead of hostility, were made agencies for individual well-being, happiness in the home, contentment in communities, peace among the nations and the ensuing spread of refinement and culture. In July, 1920, our colleague sent copies of his book, as a "limited private edition," to persons who presumably were interested. With few exceptions, the comment of correspondents implied that the new philosophy had not been assimilated, and especially that it was not agreeable to the leadership of the Socialist party in this country. The most notable exception was President David Starr Jordan of Leland Stanford University, who, in August, 1920, wrote a letter in which he not only indicated great interest in the book, but also expressed the opinion that our colleague was "on the right track."

I stated before that the manuscript represented both a heartache and a headache. Fortunately, our colleague's stomach and intestines had not been deranged. Despite the chilly reception accorded the private edition of his book, he proceeded, in August, 1921, to issue a public edition, and thus made the book permanently available to all who might care to read his convictions.

For several years, our colleague's book, although doubtless examined by many students of history and of the social and economic sciences, failed to receive significant public notice. But vital seed had been planted and signs of growth gradually appeared. Thus, in 1922, Prof. John Dewey, on pages 272-273 of his volume entitled "Human Nature and Conduct," made this acknowledgment of indebtedness to our colleague's book for a view incorporated in his own:

> Meantime class struggle grows between those whose productive labor is enforced by necessity and those who are privileged consumers. And the exaggeration of production due to its isolation from ignored consumption so hypnotizes attention that even would-be reformers, like Marxian socialists, assert that the entire social problem focuses at the point of production. Since this separation of means from ends signifies an erection of means into ends, it is no wonder that a "materialistic conception of history" emerges. It is not an invention of Marx; it is a record of fact so far as the separation in question obtains. For practicable idealism is found only in a fulfilment, a consumption which is a replenishing, growth, renewal of mind and body. Harmony of social interests is found in the wide-spread sharing of activities significant in themselves, that is to say, at the point of *consumption*. [Acknowledgment is due to "The Social Interpretation of History" by our colleague.] But the forcing of production apart from consumption leads to the monstrous belief that class-struggle civil war is a means of social progress, instead of a register of the barriers to its attainment. Yet here too the Marxian reads aright the character of most current economic activity.

A German translation of our colleague's book was published in 1924. In

the introduction, Prof. Oswald Spengler included this comment:

> He [our colleague] is right in denoting the class-warfare teaching of Marx as socio-pathological. For the class-war, when it has been unleashed by one party, has, on the whole, accomplished nothing—save to render social life more difficult and to brutalize it, and to breed a class of paid labor leaders who make a business of Marxism. In Germany, at least, that has been the consequence of the revolution. Today, it is beginning to dawn upon German labor (and this [our colleague] also rightly sees) that the worker outside the workshop is a *consumer,* and in this sense has the same interests as all the other classes. That is, in fact, the fundamental error of the class-war theory, that it would like to divide a people into classes in order to realize an ideology through their opposition. . . . For Germany, with her propensity to strange theories, [our colleague's] book is important, because it gives at last an entirely philosophical criticism of a doctrine which we take far more seriously than it deserves.

These quotations from the comment of leading philosophers represent a growing appreciation of our colleague's book among the scholars who made themselves acquainted with its merits. But the most remarkable of all the many facts that I might present is the acknowledged influence of our colleague's book on the history of China and the ensuing world relationships. Dr. Sun Yat-sen, the venerated leader of the successful Chinese revolution, in the closing period of his career, used the book for the formulation of the national program, having been converted by the book from a promarxian position in sympathy with Russian communism to an antimarxian position in accord with American ideals. A little later, a few facts in the abundant evidence of Dr. Sun's formal use of our colleague's book will be cited. Before we arrive at that point, several additional quotations will afford a brighter general illumination:

In the issue of *Asia* for May, 1927, in an article on "Sun Yat-senism," John McCook Roots wrote in part as follows:

> On the question of Marxian Socialism, or Bolshevism, Sun Yat-sen leaves no room for doubt. Sun is a social evolutionary. Marx is a social revolutionary. Marx preaches class-war. Sun believes in the necessity for cooperation between the classes. He bases his anti-Marxian position almost verbatim upon a little-known work from the pen of an American author—*The Social Interpretation of History,* by [our colleague], published in 1921. With the aid of this volume, which is a refutation of the Marxian economic interpretation of history, he [Sun] refutes the father of modern Bolshevism on all three of his principal positions—the economic interpretation of history, the theory of surplus value, and the doctrine of the class-war. On the first of these points, he [Sun] quotes word for word [in one of his published lectures] from pp. 78-79 of [our colleague's] book . . . .

In August, 1928, Dr. Groeger, the translater of the German edition of our colleague's book (mentioned above), expressed these views:

> I was of course at first immensely surprised by this revelation [of the relation of our colleague's book to Dr. Sun's], and my astonishment. . . . was still greater when I perused Sun Yat-sen's book [published lectures] and learned from it how largely he makes use of [our colleague's] ideas and philosophy. That so prominent a thinker and leader, a man of such genius and learning as this Chinese scholar, bases the most important part of his influential book upon "The Social Interpretation of History" is certainly the greatest compliment a serious author ever can earn. I am, moreover, very much inclined to think that in so undeveloped a country as China, where the masses of the people seem absolutely dependent on their leaders, the influence of a national hero, as Sun Yat-sen certainly was, could be greater than we, living in other conditions, are able to imagine. I think it therefore very probable that the defeat of Bolshevism in China was a consequence of Sun Yat-sen's book, i.e., of [our colleague's] book. This seems quite overwhelming a fact, and I feel very proud to have had the good luck to translate that wonderful book.

Prof. Jeremiah W. Jenks, who gave many years of service to China and was intimately acquainted with the leaders of the Chinese Republic, included the following remarks at New York University, Feb. 6, 1929, in a lecture entitled "Why China Repudiated Bolshevism":

> In the latter part of his book [that written after April, 1924], he [Sun Yat-sen] changed his views quite decidedly, and that change was apparently brought about by there falling into his hands in some way (we do not know how) an American book written by [our colleague]. It is entitled "The Social Interpretation of History." Dr. Sun read this book with a great deal of care, and in the latter part of his own book he adopted [our colleague's] principles. In many cases, he adopted them so completely that Sun's book is almost a transcript of [our colleague's] book. Not merely did Sun Yat-sen change his views very decidedly as a result of [our colleague's] book, but many of his generals and followers must have read Sun's book and adopted these ideas, because "San Min Chu I" [Sun's published lectures] is a well known book in all of the schools of China now, and is being used more and more as time goes on. . . . There was a long struggle between these forces [communist and anticommunist], but apparently the anti-communists have triumphed due practically entirely to the fact that Dr. Sun Yat-sen had been intellectually convinced by [our colleague's] book.

In letters written in January, 1931, Dr. J. Leighton Stuart, president of Yenching University, in Peiping, China, said, in part:

> (a) I should like to add my own admiration of the interpretation [our colleague] has given in refutation of that of Karl Marx, and my delight that this should have come to the notice of a man [Sun Yat-sen] whose writings are virtually molding the political thought of this country at so critical a time.
>
> (b) It is certainly curious that an American dentist should have turned the whole current of political thought for the man whose writings at present are the Bible of the dominant political party in this country.

The last quotation from the comment of a president of a university in China is so clear and decisive that we have logically come to the question: What can be quoted directly from the evidence that Sun Yat-sen actually used our colleague's book as represented?

The philosophy of Sun Yat-sen, as the leader of the Chinese revolution, was expressed in a number of "lectures," each given the date of delivery, and all published together in a book entitled "San Min Chu I," now the Bible of nationalist China. The lectures delivered before May, 1924, (Jan. 27, 1924-April 26, 1924) were thoroughly marxian in tone. Internal evidence and the testimony of some of Dr. Sun's intimates indicate that he received a copy of our colleague's book almost immediately after his lecture of April 26, 1924, and gave the book intensive study during the next few months, while he postponed the remaining lectures. Aug. 3, 1924, the lectures were resumed, and were continued until Aug. 24, 1924. The lectures delivered after April, 1924, were thoroughly antimarxian in tone, and represent a complete reversal in thought and objective. Dr. Sun died March 12, 1925. Into the lectures delivered after April, 1924, Dr. Sun incorporated, from our colleague's book, not only ideas but also sentences and paragraphs, directly or by paraphrase, or both. It is not a Chinese custom to indicate with quotation marks the beginning and end of quotations, but, in several general allusions, Dr. Sun acknowledged his indebtedness to our colleague, to whom he referred as an "American philosopher," but whose name was misspelled in the last syllable. For a time, this misspelling prevented identification of the "American philosopher," but when the facts were discovered, L. T. Chen, the accredited editor of the English translation (Price) of "San Min Chu I," wrote from Peking in part as follows (Sept. 12, 1928): "I first found out my mistake,

with reference to [our colleague] mentioned in the book ['San Min Chu I'], last January, when I learned from a personal friend of Dr. Sun's that 'The Social Interpretation of History' was a constant companion to him. Immediately, I notified the publishers [of 'San Min Chu I'], asking them to make the correction in the new edition." The following direct references in 'San Min Chu I' to our colleague are quoted from Price's English translation (1927):

(Pages 382-383.) An American named [our colleague], after making a deep study of Marx's philosophy, came to the conclusion that the disagreement between fellow socialists is due to defects in the Marxian doctrines. He sets forth the view that the materialistic conception of history is wrong; that the social problem, not material forces, is the center which determines the course of history, and that subsistence is the heart of the social problem. This social interpretation of history he believes is the only reasonable one. The problem of livelihood is the problem of subsistence. The new theory of this American scholar tallies exactly with the third principle of our party. [Our colleague's] theory means that livelihood is the central force in social progress, and that social progress is the central force in history; hence, the struggle for a living and not material forces determines history.

(Page 384.) According to this American scholar [our colleague], the energies of mankind, both in ancient and modern times, have been spent largely in trying to solve the problem of subsistence. The struggle for existence is one of the laws of social progress and is the central force in history. Marx's materialistic theory did not set forth any law of social progress and cannot be a determining factor in history. If we want to understand clearly the positions of these two social philosophers and to know which one is right, we must make a detailed study of their doctrines and see whether these doctrines harmonize with the facts of modern social progress.

(Page 394.) As stated by the American scholar [our colleague], the struggle for subsistence is the law of social progress and is the central force of history. The struggle for existence is the same thing as the problem of livelihood, and therefore the problem of livelihood can be said to be the driving force in social progress.

Below are given the summaries of Sun Yat-sen's Lectures I and II, on "The Principles of Livelihood" (delivered, respectively, Aug. 3 and Aug. 10, 1924), as they appear in "San Min Chu I" (Price's English translation). The items that Dr. Sun drew in whole or in part from our colleague's "Social Interpretation of History" are printed in italic; items not italicized have no relation to our colleague's book.

Lecture I. *Meaning of Min-sheng, or The People's Livelihood*—New problems of livelihood caused by substitution of machine power for human labor—How the railroads in China are supplanting coolie labor—*Relation of the Min-sheng Principle to socialism and communism. Factors within Western Socialist parties and failure of socialism to solve post-war problems—Marx's contribution to socialism—Utopian socialism and scientific socialism—Marx's materialistic conception of history criticized—The search for livelihood the central force in history—Recent social and economic developments which are disproving Marx's theory of class struggle—Social and economic reform, public ownership of transportation and communication, direct taxation, and socialized distribution discussed and appraised—Social evolution through adjustment of economic interest—"Surplus value" created by community, not by labor alone—Marx a social pathologist—Marx's forecasts of capitalist collapse not fulfilled—Gradual improvement of working conditions—Shorter day and workers' benefits have increased production—Marx's conditions for increase of surplus value contradicted by history of Ford factories—Consumers' cooperative societies in England—Importance of the consumer*—Reasons for failure of the Hanyang Iron and Steel Works—*Livelihood must be the center of the economic solar system.*

Lecture II. Methods of applying the Min-sheng Principle in China—*Equalization of land ownership and regulation of capital—Revolutionary versus evolutionary methods of social and economic reform—Class strug-*

gle possible only in highly industrialized states—Difference between Min-sheng Principle, and communism in methods rather than in principle—Absence of extremely wealthy class in China; degrees of poverty—Effects of Western impact upon land values in China; Shanghai, Canton—The problem of "unearned increment" in the West, in China —Present opposition to communism within the Kuomintang compared with former opposition to democracy—*Minsheng Principle and its relation to communism not yet understood in the party*—Equalization of landownership—Land values to be declared by owners and taxed accordingly; if assessed too low, to be bought back by the government—Future increments to revert to the community —Min-sheng Principle a communism not of the present but of the future—Land tax a source of government revenue—*Marx's methods not applicable to present situation in China*—State capital, state industries, must be developed—Foreign capital necessary at the beginning.

Many such striking agreements as the following may be found on comparing the English translation of "San Min Chu I" (1927)—Sun's lectures delivered in 1924—with our colleague's book published in 1921 (lack of space forbids more extensive illustration):

SOCIAL INTERPRETATION OF HISTORY: A REFUTATION OF THE MARXIAN ECONOMIC INTERPRETATION OF HISTORY (1921).

I

Marx was a social pathologist. He studied social pathology and mistook the phenomena he observed for the laws of social biology. The manifestations of the class struggle are symptoms of social pathology analogous to such symptoms as pain, heat, redness and swelling in human pathology. The former are no more the laws of sociology than the latter are the laws of biology [page 80].

II

Although the operations of Social Evolution in capitalist society are bewildering in their complexity, it is yet possible to discern that they are working out in four well-defined forms: (1) *Social and industrial reforms;* (2) *public ownership of the means of transportation and communication*; (3) *direct taxation*; (4) *governmental activity in the distribution of consumable wealth* [page 115.]

"SAN MIN CHU I": ENGLISH TRANSLATION—PRICE [1927]

I

Class war is not the cause of social progress; it is a disease developed in the course of social progress. The cause of the disease is the inability to subsist, and the result of the disease is war. What Marx gained through his studies of social problems was a knowledge of diseases in the course of social progress. Therefore, Marx can only be called a social pathologist; we cannot say that he is a social physiologist [page 391].

II

The interests of capitalists and of workers are constantly clashing and when no solution of the difficulty is found, a class war breaks out. . . . Marx considered class war essential to social progress, the driving force, in fact, of social progress. He made class war the cause and social progress the effect. . . . Society has made tremendous progress in the last few decades and the details of this social progress would make a complicated story. The facts on the economic side alone cannot be described in a few words. But to summarize briefly: recently economic progress in the West may be said to have taken four forms—social and industrial reform, public ownership of transportation and communications, direct taxation, and socialized distribution. These four socionomic practices have all evolved through the method of reform, and we should see more reforms and increasing improvements as time goes on [page 385].

III

We have seen that Social Evolution has forced the state to attack the capitalist system from four different "fronts": (1) social and industrial reform; (2) the elimination of the capitalist principle from transportation and communication; (3) direct taxation; and (4) distribution [page 188].

III

Many Western scholars are opposing Russia's revolutionary plan and are advocating political action instead. . . . They think that only peaceful methods will fully settle the problem. These peaceful methods are the four which I described in my last lecture [above]—social and economic reform, nationalization of transportation and communication, direct taxation or the income tax, and socialized distribution or coöperative societies. They are quite different from the methods which Marx proposed . . . . In dealing with our social problems, shall we "cut the tangled hemp with a sharp knife" [elsewhere he says no] or shall we employ peaceful methods, such as the four policies we have already described [above]? [pages 410-412].

In comparing these illustrative quotations, it should be noted that our colleague's comment (1921) was translated by Sun Yat-sen into Chinese (1924) and then reconverted into English by the translator of Dr. Sun's "San Min Chu I" (1927), Frank W. Price, who apparently was unaware of the existence of our colleague's book.

Our colleague has been persuaded to write a book on matters affecting the relationships between China and the United States, with a view to removing present international misapprehensions. In this book, the foregoing historic facts and many other data will be presented in detail. The book, to be entitled "Sun Yat-sen Versus Communism—New Evidence Establishing China's Right to the Support of Democratic Nations," will show that the Chinese revolution has not had a communist culmination, and will certainly improve understanding, good will, intercommunication and trade accord between China and the United States. Secretary Wilbur of President Hoover's cabinet, after examining the available evidence, has written for our colleague's new book the following foreword, in which the influence of our colleague's first book on Sun Yat-sen is noted:

There is a constant growth and change and shift in emphasis in what we call society or social structure. The evolution of these social processes is going on about us all of the time. Much of it we study and call history, but history is in the making in this present decade to an almost unprecedented extent. Under the guidance of Franklin, Washington, Jefferson and their associates, the Constitution of the United States was put together as a result of age-old ideas and the great mass of new ones brought in by the movement most sharply characterized by the French Revolution.

Again we are in a period of revolution which is associated with industrial and social changes of major magnitude. The sharpest social reactions have been in Russia; but after centuries of fairly uniform progress and crystallization, the hundreds of millions of the people of China are on the move. They rejected the past when they cut off their queues. They are assimilating the present at a rapid pace. Their young men and young women have been sent out to all parts of the world to gather experience and information and to become guides of China's future. They have felt the impact of both the American and the present Russian economic, social and political philosophies.

There is a gigantic struggle going on between these two ideas under hard conditions favorable to drastic changes. The leadership of Sun Yat-sen has had almost a re-

ligious significance. His writings not only show the changes that come with advancing years and a strong sense of responsibility, but reflect the influences that have come upon him. The interaction of mind upon mind shown by the effect of [our colleague's] "Social Interpretation of History" upon Sun Yat-sen is dramatic, if not epochal. The soil has much to do with the growth of the seed which find lodgment in it. Sun Yat-sen's mind was typical of that of the progressive Chinese. The points in [our colleague's] book found hospitable lodgment in his mind, and, interpreted by him, they have become of great significance in the unfolding of the new China.

I wish that our colleague were here so that I might now present him in person. He had the fidelity of spirit to examine thoroughly the foundations of his faith, and the moral courage to rebuild his beliefs on the basis of broader and deeper truth as he found it. His fraternal spirit led him to present his revised views to associates and friends for such advice as they might offer. He saw that their indifference was not based upon understanding. His strength of character led him to submit his convictions to the free judgment of the world. His confidence sustained him while his work remained seemingly unnoticed. His modesty restrained him as the tide of approbation rose and culminated in the revised policy of the heroic leader of a people, and in the program of the great nation that this leader recreated. Our colleague's book has become a decisive influence in world history. The spiritual and intellectual character of his achievement will always be among the irreducible assets of American dentistry.

Our colleague is a member of the American Dental Association, of the Dental Society of the State of New York, of the First District Dental Society of the State of New York, of the Allied Dental Council of New York, of the Dental Advisory Board of the New York Department of Health, of the Committee on Community Dental Service of the New York Tuberculosis and Health Association, of the Oral Hygiene Committee of Greater New York. He practices dentistry at 130 West Fifty-seventh Street, New York City. His name is Maurice William.

REACTION OF RAT TISSUE TO IMPLANTED ROOT ENDS*

By EARL P. BOULGER, D.D.S., L.D.S., Chicago, Ill.

VIGOROUS controversy has existed for years regarding the justification for treating pulp canals. The medical profession and a large group of the dental profession criticize this phase of dentistry rather severely. On the other hand, there are dentists treating pulp canals who are successful in their results and show clinical evidence to support their assertions. But the question arises: How is it possible to control results? Again, is the information about the condition of a treated tooth that we are able to obtain by our present-day methods

*From the Research Department (Director, Rudolf Kronfeld), Chicago College of Dental Surgery, Dental Department of Loyola University.

sufficient and reliable? Clinical, roentgenographic and bacteriologic studies have not as yet given us generally accepted evidence for the justification of pulp canal therapy, and this fact has prompted us to attack the problem from a biologic standpoint. We hope by pursuing our studies from a point of view different from what has formerly been taken to secure information that will be of value in this work.

The ideal method would consist of microscopic studies of human treated teeth *in situ*. Studies of healthy teeth in jaws secured by means of necropsy have taught us the normal condition of the tissues surrounding the roots. It has also been shown that, in such sectioned jaws, the periapical tissue has undergone typical changes when an infected pulpless tooth was present. From these studies, we get a clear conception of the ideal condition

Fig. 1.—Snipping the apex of an extracted root for implantation in rat tissue.

Fig. 3.—Rat with the apical end of a root in the rat tissue. *A*, root end, *F*, femur of rat.

Fig. 2.—Rat on the operating board. An opening has already been made in the muscles of the right hind leg for the insertion of the root end.

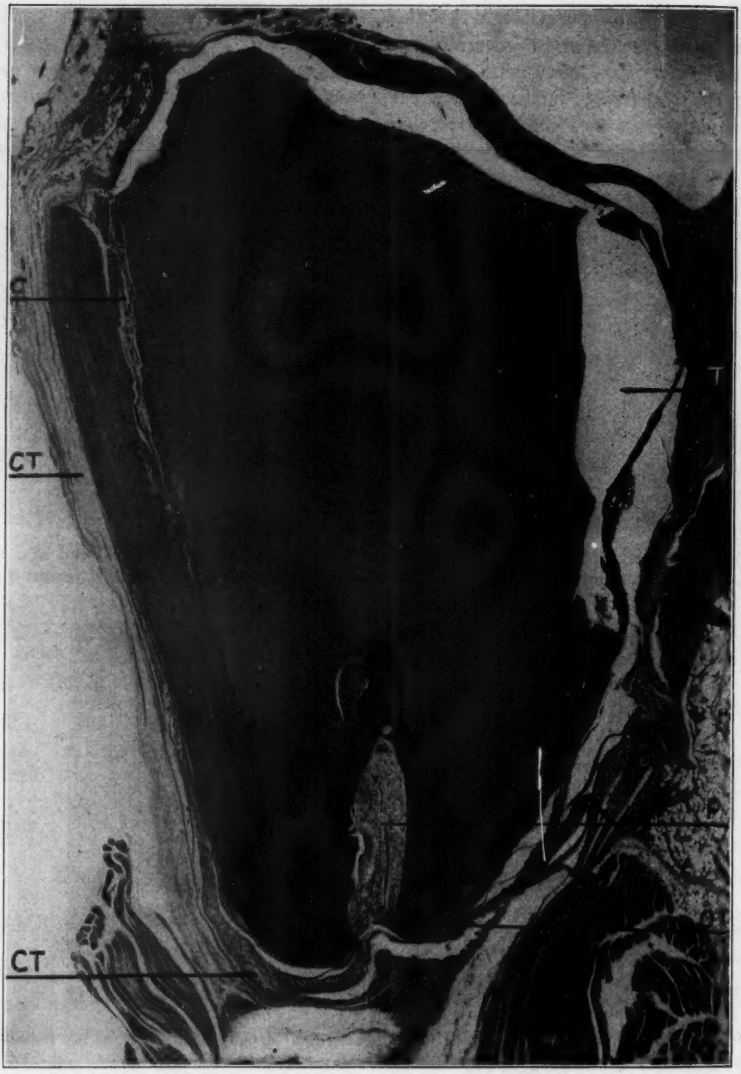

Fig. 4.—Root end of a healthy living tooth embedded in rat tissue. *CT*, connective tissue of rat free of inflammation. *P*, remnants of pulp tissue which has undergone degeneration and is being replaced by rat tissue. *T*, tear caused by preparation. *C*, crack caused in snipping the apex from the root.

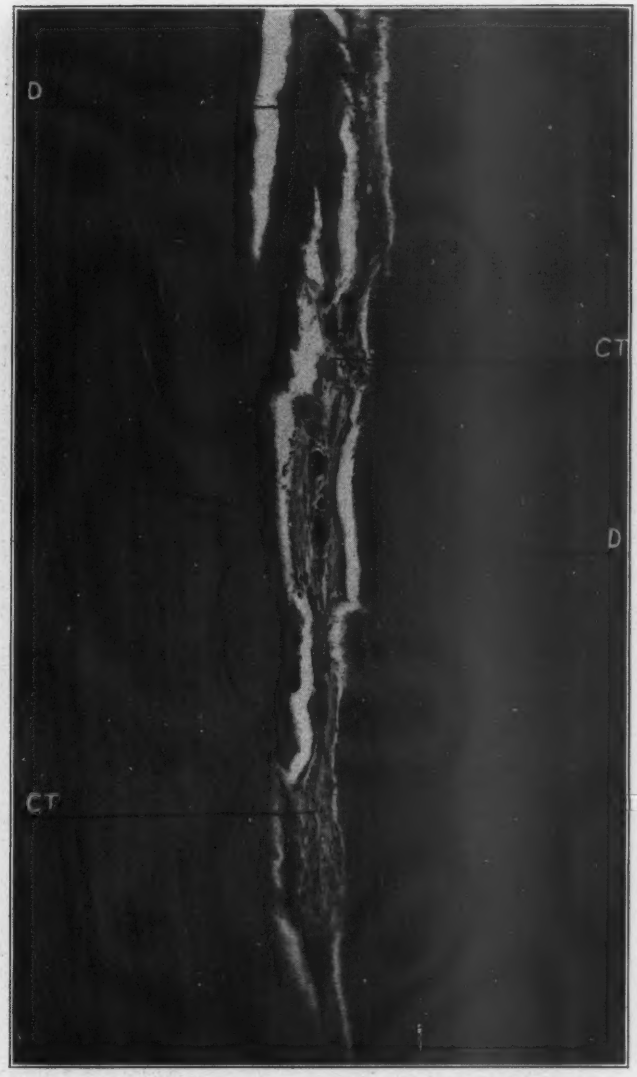

Fig. 5.—Higher magnification of crack (Fig. 4 *C*). *CT*, connective tissue of the rat which has been growing into the opening. *D*, dentin.

expected to be present around a tooth having a successfully treated pulp canal. The tissue must approximate that found around a normal tooth as closely as possible. At least, it must be scar tissue without any symptoms of inflammation.

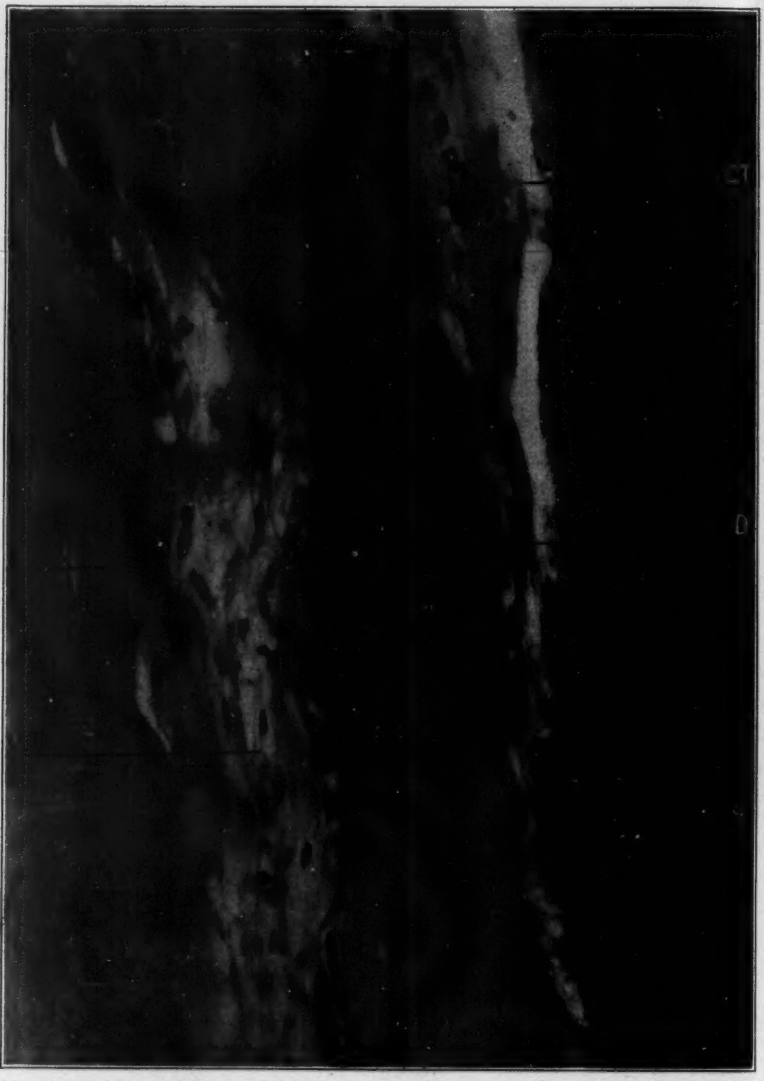

Fig. 6.—Higher magnification of Figure 5, showing the type of tissue in the crack. *D*, dentin. *CT*, connective tissue of rat.

As it is impossible to secure such material with filled teeth of known histories, we endeavored to find some medium to simulate the condition about the end of the root.

In accordance with the methods used

Fig. 7.—Apical end of tooth shown in Figure 4. *CT*, connective tissue of the rat. *P*, pulp tissue showing round-cell infiltration.

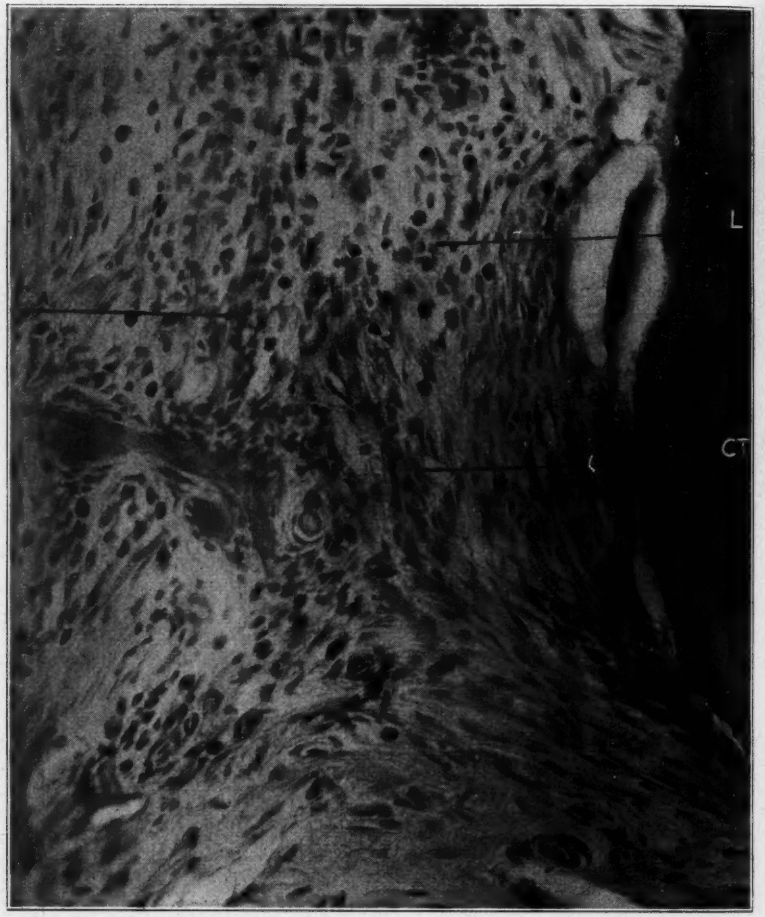

Fig. 8.—Higher magnification of area *X*, Figure 7. *CT*, connective tissue of the rat. *Ca*, capillaries growing into the pulp tissue. *L*, leukocytes of the rat tissue penetrating into the pulp tissue.

and suggested by Gottlieb, Schwarz and Stein,[1] the muscle tissue of white rats was chosen as a testing medium for our experiments. In this tissue, the root ends were implanted and the tissue reaction was studied. Similar experiments have been made by Oscar Mueller,[2] who implanted apices in the ears of rabbits and found corresponding reactions. We are,

1. Gottlieb, Bernhard; Schwarz, A.M., and Stein, Georges: Das Problem der Wurzelbehandlung, Ztschr. f. Stomatol., Vol. 26, No. 12, 1928.

2. Mueller, O.: Wurzelfuellungsmethoden, Fortschr. d. Zahnheilk., Vol. 5, No. 6 (Fig. 346-349) (June) 1929.

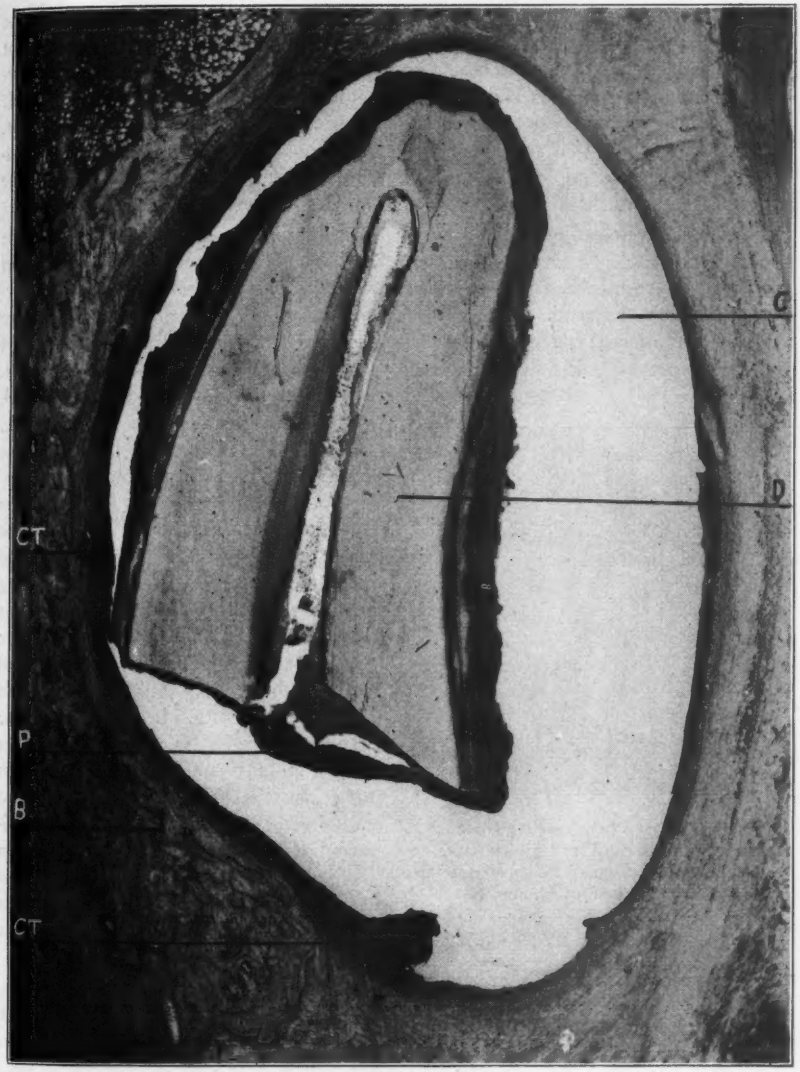

Fig. 9.—Untreated infected root end implanted in rat tissue. *C,* abscess cavity. *P,* pus cells and necrotic tissue. *B,* bone of the femur. *CT,* connective tissue of the rat.

of course, aware that there is a difference between rat and human tissue; but as long as science is working on culture mediums, and as long as certain changes occur consistently and uniformly in these mediums under the same given conditions,

we are justified in using such mediums for our studies and, within a reasonable limit, in drawing practical conclusions. The employment of mediums in biologic and bacteriologic fields has been accepted for years, and we know that the use of culture mediums in bacteriology has proved of infinite value to the investigators.

For our investigations, teeth were chosen which could be extracted without contamination, and when the diagnoses indicated their removal. Immediately after the operation of removal, the apical ends were cut off with sterile forceps.

Fig. 10.—Upper lateral incisor from which the pulp was removed and which later became infected. Sections of this root end after implantation are shown in Figures 11-13.

(Fig. 1.) The muscle tissue of the leg of the rat was chosen for the site of the implantation, and the hair was removed in this area. A sterile napkin (Fig. 2) covered the field except at the point of incision. The animal was anesthetized with ether, the muscles were dissected and an opening was made for the insertion of the root end. Catgut was then used to close the wound and the rat was kept on a normal diet for three months, or, in some instances, longer periods. Thereafter, the animal was killed and the implanted root end sectioned, its relation to the surrounding structures being maintained. Figure 3 shows the hind legs of a rat. The implanted apex containing a guttapercha filling can be plainly seen in the muscles of the right leg.

Primarily, it was necessary to learn the reaction of rat tissue to the presence of sound teeth with healthy gums and normal pulps. The reaction of rat tissue to such apices appeared uniform. Figure 4 is a typical example of such a root end. The connective tissue of the rat (Fig. 4, *CT*) surrounds the whole fragment and is free of inflammation. The pulp tissue in the canal (*P*) is gradually being replaced by the rat tissue (*CT*), and there is no evidence of infection. The rat tissue grows down into a crack, which developed in the tooth structure during the snipping off of the apex. (Fig. 4, *C.*) Figure 5 is a higher magnification of this crack. The rat tissue (*CT*) has proliferated and grown into the crack and completely fills it. A similar reaction is shown where the rat tissue organizes and replaces the human pulp tissue in the canal. Both these reactions appear constant in root ends free of infection. A higher magnification of the tissue in the crevice is shown in Figure 6. The fibroblasts have grown into the smaller cracks and the cells lie along the walls of the fractured surface without any inflammatory reaction.

The crevice formed between the cementum and dentin (Fig. 5) into which the rat tissue has proliferated eliminates the criticism of the "foreign body reaction." The nature of the tissue that has grown into this space and filled it is shown in Figure 6. The approximation of this tissue to the one found normally in the body of the rat, and the normal

Fig. 11.—Infected root end of the upper lateral incisor shown in Figure 10 in the rat tissue. *D*, dentin. *CT*, connective tissue of the rat. *GP*, guttapercha filling. *SP*, surplus filling material. *R*, round-cell infiltration denoting infection on the fractured surface, at the apex and around surplus filling material. *T*, artificial separation of tissue from the root end. *M*, muscle tissue of the rat.

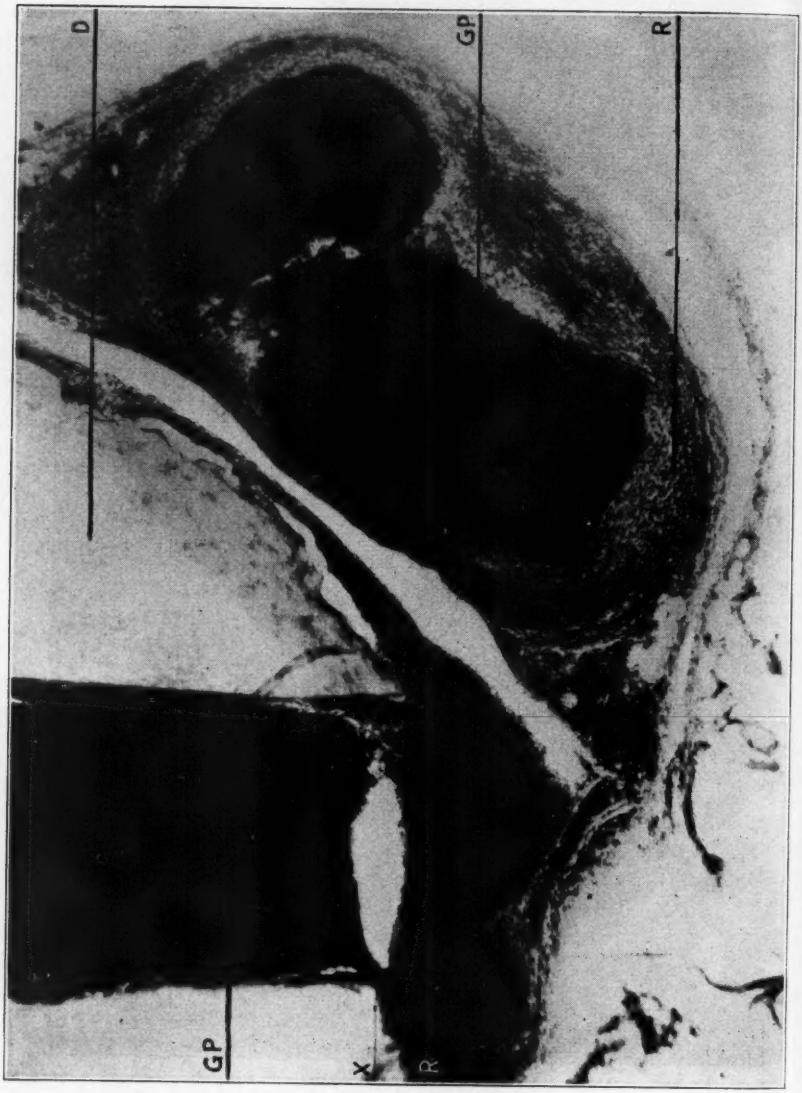

Fig. 12.—Higher magnification of apex in Figure 11. *D*, dentin. *GP*, guttapercha filling. *R*, round-cell infiltration.

Fig. 12.—Higher magnification of apex in Figure 11. *D*, dentin. *GP*, guttapercha filling. *R*, round-cell infiltration.

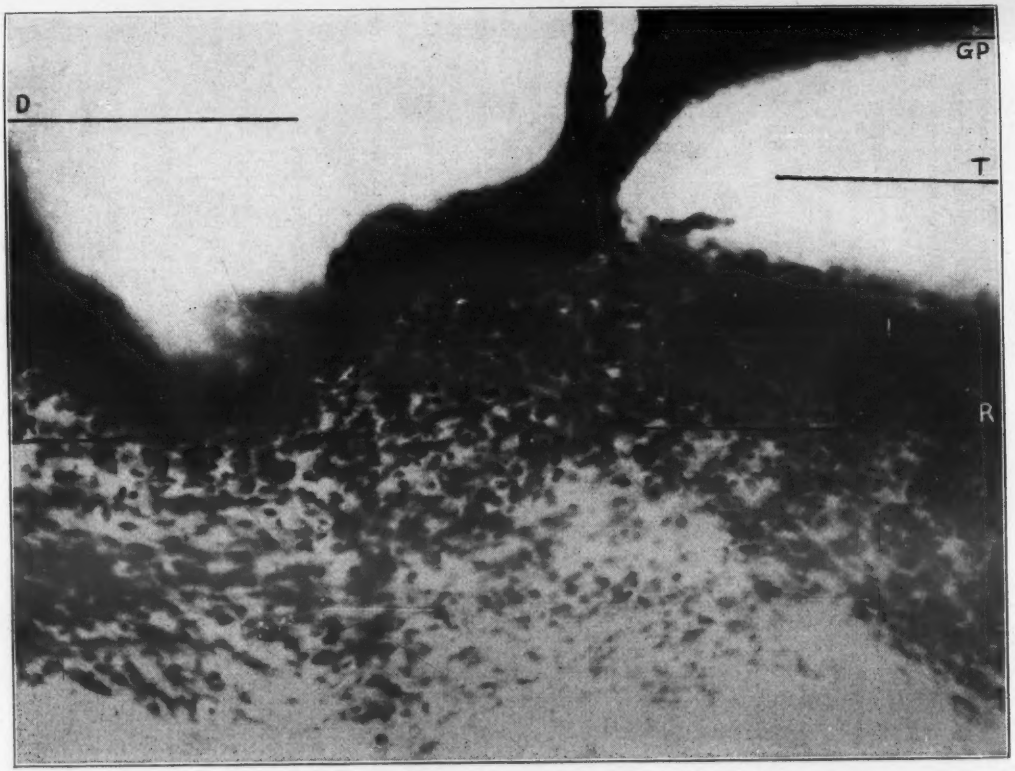

Fig. 13.—Higher magnification of area *X*, Figure 12. *GP*, guttapercha. *D*, dentin. *R*, round-cell infiltration. *T*, tear (artefact).

appearance of the fibers and fibroblasts, clearly point out the absence of any effort of Nature to eliminate the root end as a foreign body. The root end is tolerated and well healed in.

The organization of the human tissue in the pulp canal by the rat tissue is very interesting. The rat tissue has grown into the canal, replacing the degenerated pulp tissue. A higher magnification (Fig. 7) shows this condition. At the lower margin of this picture, we see the normal dense connective tissue of the rat. The area occupied by the human pulp (*P*) shows an ingrowth of rat capillaries and round cells of rat origin.

Fig. 14.—Upper second bicuspid having a gangrenous pulp which was treated and the canal filled with guttapercha. Figures 15-17 are taken from this specimen.

The latter signify the phagocytic action of the rat cells toward the implanted human tissue. (Fig. 8.)

Having ascertained the reaction of our culture medium, i. e., the reaction of rat tissue to healthy root ends, the next logical step was to learn its behaviour toward infected apices. Pulpless teeth were selected which were positively infected, and the root ends were implanted similarly to the healthy teeth.

A roentgenogram (Fig. 10) depicts the type of teeth chosen for this part of the experiment. Evidence of infection indicated by the bone resorption around the apex was borne out bacteriologically.

Microscopic studies of the sectioned rat tissue with these teeth disclosed conclusive evidence of infection. The infected teeth caused a marked inflammation of the rat tissue surrounding them. The implanted apex of an untreated gangrenous root lies in an abscess cavity in the rat tissue, surrounded by a band of highly infiltrated connective tissue. (Fig. 9, *CT*.) Areas of similar tissue are noted at different points. Pus cells and necrotic tissue are quite evident. This root end was lying in close proximity to the femur of the rat, and the inflammation caused resorption of the bone of the femur, *B*. This specimen is a typical example of the reaction caused by the implantation of such infected apices.

Infected teeth with known treatment histories were then used. These teeth had been treated in our clinic. An infected root end (Fig. 11) was the cause of interesting developments when implanted. The pulp had been removed from this tooth with arsenical paste and filled with guttapercha four months previous to extraction. The rat tissue at the apex (Fig. 11) and the fractured surface are highly infiltrated, while the tissue along the side of the root is not so much affected. The guttapercha that was sterile when introduced into the root canal (*GP*) in all likelihood became infected from the contents of the canal. The surplus filling material (*SP*) at the apex is surrounded by a layer of densely infiltrated tissue. A higher magnification of the apex (Fig. 12) shows more clearly the infected guttapercha with the round-cell infiltration. Evidence of infection can be noted at the end of the root adjacent to the guttapercha in the canal. The dense round-cell infiltration in this area becomes more

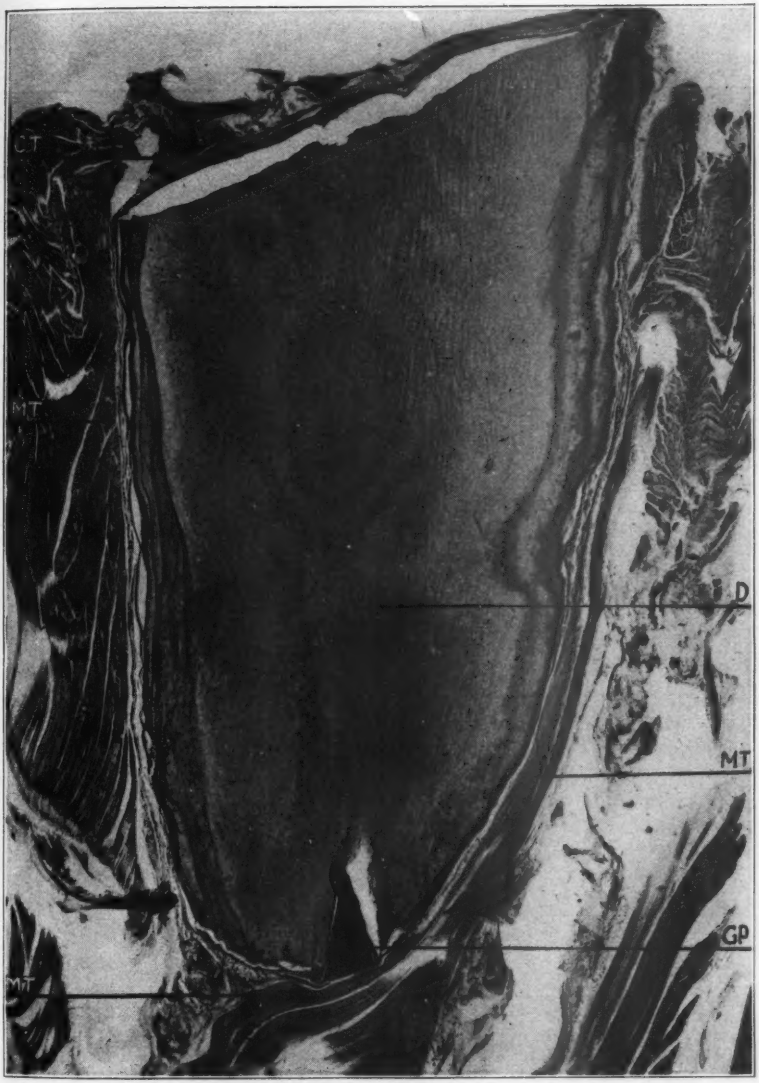

Fig. 15.—Root end embedded in rat tissue (Fig. 14). *D*, dentin. *GP*, guttapercha cone in the apical foramen. *MT*, muscle tissue of the rat lying at the apex in close apposition to the guttapercha cone. *CT*, connective tissue capsule.

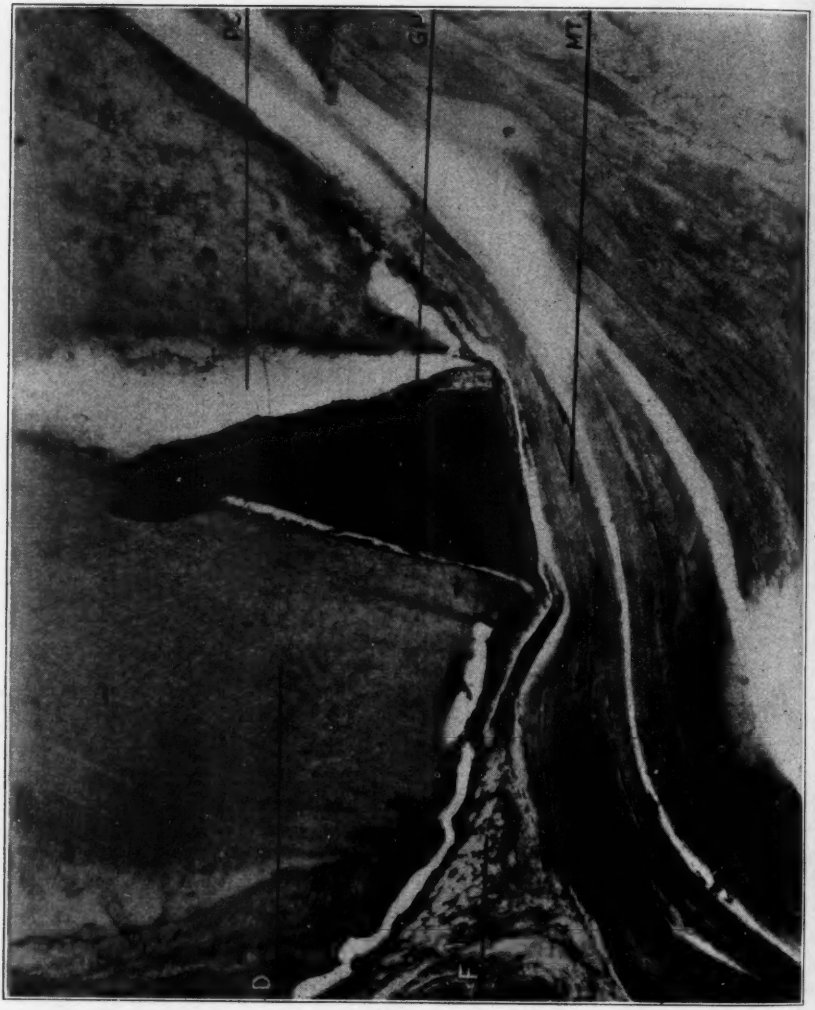

Fig. 16.—Higher magnification of the guttapercha cone at the apical end. *GP*, guttapercha. *PC*, pulp canal. *D*, dentin. *MT*, muscle tissue of the rat. *F*, fat tissue. The guttapercha has been partly torn away from the walls of the pulp canal in sectioning.

Fig. 16.—Higher magnification of the guttapercha cone at the apical end. *GP*, guttapercha. *PC*, pulp canal. *D*, dentin. *MT*, muscle tissue of the rat. *F*, fat tissue. The guttapercha has been partly torn away from the walls of the pulp canal in sectioning.

Fig. 17.—Higher magnification of the rat tissue in apposition to the guttapercha. *CT*, connective tissue of the rat. *GP*, guttapercha. *MF*, muscle fibers of the rat.

evident in Figure 13, which shows the apex and the end of the guttapercha in the canal.

Following the plan previously mentioned, we determined the reaction of rat tissue to the apices of healthy teeth and infected teeth. The healthy root ends, on the one hand, and the infected roots, on the other, disclosed radically different reactions. This fact led us to believe that the treated tooth would show either a reaction similar to one of these extremes or one between these extremes. The next step was to ascertain the reaction of treated teeth with known histories which appeared free of infection.

Fig. 18.—Upper cuspid from which the pulp was removed under infiltration anesthesia. Figures 19-21 are taken from this specimen.

The root end in the roentgenogram (Fig. 14) is that of a tooth having a gangrenous pulp which was treated with formocresol. The pulp canal was filled with guttapercha and some surplus material passed beyond the apex as shown in the roentgenogram. The apex was implanted (Fig. 14), and became well healed in the rat tissue without evidence of infection at the apical opening or on the fractured surface. The guttapercha is so well tolerated by the rat tissue that the muscle fibers lie in close apposition to the filling. (Fig. 15, *MT.*)

A higher magnification of the guttapercha in the foramen (Fig. 16) shows more clearly the proximity of these muscle fibers to the filling material, and the absence of inflammation in this tissue. This specimen is particularly interesting since the pulp was infected previous to treatment. The important point in regard to this specimen is that the behavior of the rat tissue on implantation of the root end is similar to its reaction to the presence of apices of normal healthy teeth. The normal condition of the cells (Fig. 17, *CT*) as they lie along the surface of the guttapercha filling is further evidence of the contention that infected teeth may be treated successfully.

Another interesting case was that of a tooth from which the pulp had been removed under infiltration anesthesia. The root end was implanted in rat tissue and became well healed in. The roentgenogram (Fig. 18) shows the tooth and the surplus guttapercha which has passed beyond the apex. The apex showing this surplus material (Fig. 19, *GP*) is surrounded by connective tissue of the rat free of inflammation. A small piece of dentin, *D,* which has been torn away from the wall of the canal during the root-canal work has become imbedded in the guttapercha. The rat tissue lies in close apposition to it. The fractured surface of the root end (Fig. 20) showing the guttapercha filling in the canal is covered by a layer of rat tissue. This fact points to the absence of infection in the canal.

A small fragment (Fig. 19, *B*) broken off in the operation lies in the rat tissue and is healed in, free of inflammation. The reaction of the rat tissue to this root end likewise simulated the reaction to the

Fig. 19.—Treated root end in rat tissue. *D*, dentin. *M*, muscles of the rat. *GP*, guttapercha. *D*, spicule of dentin embedded in the guttapercha. *FT*, fat tissue of rat. *S*, fractured surface. *B*, fragment broken from the root end.

Fig. 20.—Fractured surface of the root end in Figure 19. *GP*, guttapercha. *D*, dentin. *M*, muscle tissue of the rat. *FT*, fat tissue of the rat. *B*, fragment broken from the root end. The condition of the rat tissue about this treated tooth is similar to that about the healthy root end in Figure 4.

healthy tooth. This similarity of reaction to treated teeth and to vital teeth demonstrates that the pulpless tooth may be as well tolerated by the rat tissue as is the vital tooth. The conclusion that such treated teeth, free of infection, may be

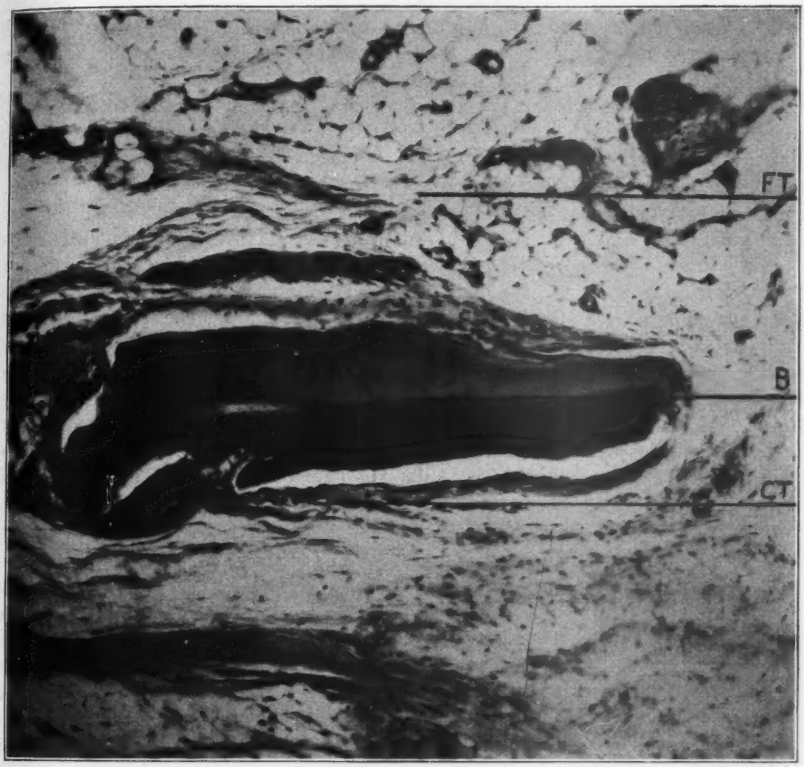

Fig. 21.—Higher magnification of *B*, Figure 19, showing a fragment broken from the tooth healed in the rat tissue. *B*, fragment. *FT*, fat tissue of rat. *CT*, connective tissue of rat.

tolerated in position in the human jaws just as well as are vital teeth appears reasonable.

The toleration of the pulpless tooth in the jaws has been pointed to, time and again, by the massive amount of clinical and roentgenographic evidence. As histologic research by Coolidge,[3] Hatton[4] and others substantiates these findings, our conclusion is not far fetched when we make the statement that, if such apices are well healed in by the rat tissue, these teeth may be tolerated by the individual without fear of systemic disturbance.

Figure 21 shows a high magnification of the tooth fragment shown in Figure 19. The rat tissue has healed in this portion of tooth structure on all sides and is free of inflammatory change. Under these circumstances, the dentin, at this point, should be free of infection. The action of rat tissue in such instances simulates the condition found in the human jaws

3. Coolidge, E. D.: Root Resection as a Cure for Chronic Periapical Infection: Histologic Report of a Case Showing Complete Repair, J.A.D.A., 17:239-249 (Feb.) 1930.

4. Hatton, E. H.: Histopathology of Apical Region of Teeth with Partly Filled Root Canals, J.A.M.A., 77:1805-1808 (Dec. 3), 1921.

about fractured teeth free of infection, as reported by me[5] and by others.

From the evidence presented, it seems within reason to conclude that the infected root end shows a reaction opposite to that of the healthy vital tooth. Also, the root ends of treated teeth which, from the clinical standpoint, appear normal cause a reaction similar to the reaction to healthy teeth. If the reaction to such treated teeth approaches so closely the reaction to healthy teeth, it seems reasonable to presume that treated teeth in the human jaw would not be any more a focus of infection than would healthy teeth. We are aware that there are treated teeth the presence of which has a bearing on the systemic condition of the patient, but such teeth show definite evidence of infection either clinically or roentgenographically. There are, on the other hand, thousands of treated teeth which are extracted because of suspicion of a focus without evidence to warrant such procedure.

The reaction of rat tissue to implantation of root ends, be they infected or otherwise, simulates very closely what we believe from our studies occurs around the apices of such teeth in the human jaws. It seems reasonable, from this work, that the pulpless tooth without positive evidence of infection is not such a menace to the health of the patient as we are sometimes led to believe; likewise, that many pulpless teeth which are comfortable and roentgenographically negative would not be doomed to extraction if it were possible to make a microscopic study of the tissue about the apices. We are led to believe that every radiolucent shadow indicates a possible source of infection, while it may have but temporary significance, indicating the formation of scar tissue or repair. The implantation of human apices might be a method of gaining further information on this question.

The Scientific Commission of the International Dental Federation (F. D. I.) has suggested such implantation as a method of control in root-canal treatment. Nevertheless, the final decision of the question — what method of control should be most highly recommended—has been postponed, in consideration of the great responsibility involved therein. This discussion will be carried on at the International Congress in Paris, 1931.

5. Boulger, E. P.: Histologic Studies of a Specimen of Fractured Roots, J.A.D.A., 14: 1778 (Sept.), 1928.

GOLD FOIL VS. GOLD INLAY RESTORATIONS*

By JAMES MARK PRIME, D.D.Sc., F.A.C.D., Omaha, Nebr.

ONLY by years of experience with both gold foil and gold inlay restorations can we arrive at a fair evaluation of each. By watching restorations of our own and our fellow practitioners for many years, especially in mouths in which both cast gold inlays and gold foil have been used, we can make an estimate of their relative value.

My practice has been conducted in a locality where the use of gold foil has been taught and practiced extensively. If I had not used gold foil extensively, and had I not had the opportunity to observe the work of others who have done likewise, I would not offer my opinion on the relative value of the two methods.

My opportunity to observe the results obtained by good inlay workers has likewise been good. In my locality are men who have devoted much time to developing a technic for handling this valuable means of restoration, and I think their work compares favorably with that done elsewhere.

I have spent much time in attempting to improve my work along this line. In fact, my time devoted to study, experimenting and cost of equipment far outweighs that associated with any other technic that I have studied.

*The papers of Drs. Prime and Grunn were presented as a symposium.

*Read before the Section on Operative Dentistry at the Midwinter Clinic of the Chicago Dental Society, Feb. 4, 1931.

CAVITY PREPARATION

First, let us compare the modes of cavity preparation. We are going to presume that a good cavity is to be made, whether we fill it with gold foil or a cast gold inlay. That is a prerequisite for either.

If a cavity preparation is poor—if a cavity is cut too shallow or too deep and thereby failure is invited either through recurrent decay or loss of the pulp, we shall not charge the failure to the fact that it was filled with an inlay; neither shall we charge it against foil, should such a misfortune follow.

Only where deep seated caries is present should we consider making deep cavities. We will grant that deep cutting is not necessary with either method. With the small burs and cutting instruments now available, we are able to prepare cavities with much less destruction of tissue than was practiced in the days before the development of the theory of focal infection.

We must not presume that the fields for the methods overlap. There are certain conditions that quite definitely limit us in the choice of technic for filling.

Many times we apply the dam and begin cavity preparation with the intention of employing gold foil, but because we find more extensive decay than we had anticipated, we conclude that a better operation is possible with an inlay.

At all times, the well-being of the tooth must take precedence over any par-

tiality we may have for a certain technic.

The inlay requires a cavity of precision; otherwise, the wax model will be distorted, and the casting be imperfect. How many times faulty cavities cause misfits and call for makeovers! Careful inlay workers are realizing this more and more, and, as a result, more time is being spent on the cavity. Walls must be smoothed almost to a polish, undercuts removed either by further cutting or by filling with cement, all of which extends the time of cavity preparation.

The inlay requires, in the majority of cases, more care, more accuracy, more attention, more skill, more time in the preparation of the cavity than does foil.

SKILL

A comparison of the skill required by the foil worker with that demanded of the inlay worker would precipitate much discussion. Again, this can be reasonably determined only by those operators who have had wide experiences with both technics, and, as a result, have acquired considerable skill in both. Unfortunately, these operators are in the minority, most men having neglected their foil, and, so to speak, having become "inlay minded."

The general opinion prevails that foil requires the greater skill. This point, in its final analysis, resolves itself into personal opinions, and these opinions are based upon such varied experiences and, more or less, prejudices that comparisons become futile. It is my opinion that with foil, less time is required to gain a working proficiency than with the inlay. I venture to say that this opinion is shared by most operators who have been making extensive use of both technics over a number of years.

TIME

Comparison of the time required by the gold inlay and foil filling is difficult, unless a concrete case is at point. When the extra time necessary for cavity preparation, wax manipulation, laboratory work, final adjustment and fitting in cavity and cementation is considered, the foil filling, in the aggregate, wins by a good margin.

Time is only one of many factors in a filling operation. We consider it one of the least important. Time and other factors must give the right-of-way to results. Results are what we are striving for and must take precedence over all else. Neither the inlay nor the foil filling should ever be thought of as offering a quick method of restoration.

PROTECTION OF THE DENTAL PULP

The dental pulp has assumed such importance in dental operations that its protection is a prime factor. The loss of this organ, in many cases, has been attributed directly to gold foil. I am not going to make wholesale denial of this charge. No doubt, in many cases charged to the use of gold foil, the cause was something else. Unnecessarily deep cutting for foil fillings has been the greatest single cause of pulp death. It is a gross injustice to charge this practice against gold foil. The situation will maintain as long as operators force their cavities to meet the requirements of the filling material, rather than forcing the material to meet the requirements of the tooth.

Because of its unequaled property of filling a cavity so tightly that moisture cannot enter at any point, it is, in properly prepared cavities, in competent hands, and in those cavities where it is indicated, the greatest protector that we have for the dental pulp. Death of the pulp under foil fillings is a thing almost unknown in my office.

PROTECTION OF ENAMEL MARGINS

It is in the protection of enamel margins that gold foil has stood out as the peer of all materials over the many years that it has been used. What is one of the weakest characteristics of other materials becomes one of the strongest of gold foil. In fact, gold foil is the only material possessing this property to any marked degree. Gold foil wedged tightly against enamel rods, either long or short, will support them. A simple fact, simply stated. It is not a theory; it is a truth fully demonstrated.

CONTACT POINT

As to contact point, the cast gold inlay has a decided advantage. The proximal surface may be better formed and a longer wearing contact point be made with the inlay. Though it is more difficult, a very good contact point can be made with the foil. That part of the filling making the contact must be most thoroughly condensed and must be finished very smoothly; which often requires the aid of a mechanical separator.

TOOTH FORM

As for tooth form, the cast gold inlay again has a decided advantage. In this respect, the inlay holds perhaps its greatest value. Very good tooth form may be had with foil, even if it does come at greater cost in time and labor. By reason of the wax's lending itself so easily to carving, we often see, as a result, "nature faking," grotesque forms which work great hardship on the periodontium.

THE PATIENT'S POINT OF VIEW

When regarded from the patient's point of view, the inlay must be given a slight advantage. This is another point on which there is not full agreement. A patient who desires good work will not complain of either. There are many angles to this point and time forbids going into them. My patients do not complain when I place foil fillings for them. The patient who understands the advantages of each will usually express pleasure when the decision is made to use foil.

To have patients sleep during foil operations, though the statement usually provokes mirth among inlay advocates, is a common experience with the gold foil operators.

ASEPSIS

In asepsis, foil stands alone. Its competitors cannot even approach it. To compare foil and the cast inlay in this respect is to compare an operation approaching surgical cleanliness with the one having the weakest chain of asepsis of all fillings.

One stands at the extreme in cleanliness, the other, as it is ordinarily handled, at the extreme in uncleanliness. One is made in a dry, clean, fresh cavity; the other, in a cavity flooded only a moment before with the most highly infected fluid of the body; one made with a material perfectly sterilized in a flame an instant before it goes into the cavity; the other, pressed into cement, which, piston-like, forces the infection deeper into the tissues.

THERMAL CONDUCTIVITY

Deep cavities, especially those near the pulp, require a protective cement base regardless of the material with which they are to be filled. It is generally thought that foil is the greater conductor of thermal shock in that part or that all of the metal is in direct contact with the tooth tissues. I am disposed to believe this is, to a small degree, true. Again, deep cutting, often under procain, has been and is the primary cause for this shock, not only with foil, but also with other materials. We think that we have more complaint regarding inlays than we

do regarding foil, but it must be remembered that we are filling the larger and deeper cavities with inlays, and this no doubt accounts for much of this difference.

Put foil where it is indicated and in shallow cavities, and this trouble will disappear like snow beneath a Florida sun.

PROTECTIVE FILLINGS

When the enamel is worn on the cusps to the point where the dentin is exposed, we usually find a small concavity appearing. If this is allowed to go on, the tooth, as you know, is soon worn away, and the bite closes.

The operator who does not use foil has no help for these patients. These concavities cannot be filled with either inlays or amalgam. What excuse has the inlay man to offer the patients who require this class of service?

USE OF THE DAM

In my practice, I use the dam for preparing all cavities, regardless of the filling material used. The only exception would be in deciduous teeth and when the teeth are too short to hold the clamp or cavities are too high gingivally. Inlays are also set under the dam. We realize this is not the custom of most operators. Foil compels the use of the dam. To train the operator in its application and use would justify the use of foil if there were no other reasons. It is a sad commentary on modern dentistry that the use of the dam is passing. Some dentists boast of having no dam in their offices. By the same token, they might boast of not washing their hands.

VARIABLES

We heard little of the word "variables" before the cast gold inlay made its advent. Although amalgam and cements have many variables, it took the cast gold inlay to make us realize the meaning of the word. Every step and every material, beginning with the wax pattern, to the cementation, are associated with variables and uncertainties. Physicists have estimated them at from 25 to 100.

Gold foil has one variable, a very important one; and so variable is it that a gold foil operation may be the best one yet known in dentistry, or the poorest.

That one variable is the operator. It is his to choose the cavity where foil is indicated. It is his to prepare the cavity correctly. It is his to fill it well or poorly. There is no operation in dentistry in which he may put so much of his individuality, or so little; no operation in which success or failure is held up before him so glaringly. It is his to choose. No other material carries such a uniformly high degree of excellence. Practically all manufacturers make good gold. Its qualities are as dependable as the law of gravity; truly, it is a noble metal.

ECONOMIC ASPECT

We come now to a point in which we and the patient are commonly interested. If we are fair, if we are honest, if we are true to the traditions of our profession, we will weigh all things from the standpoint of our patients first. What is best for them is and should be best for us. If we lay any claims to ethics, we cannot evade this duty. Granting the proven fact that a well-made foil filling is the most enduring thing done in dentistry, and on the old adage that a "laborer is worthy of his hire," the operator may and should ask more for this than, perhaps, any other service rendered that requires an equal amount of time.

Take stock, if you dare, of the time and money spent for equipment, for your inlay armamentarium, running over a period of twenty years into thousands of

dollars, and compare it with the little time and money you have invested in foil work. Your small foil investment will pay bigger dividends than any other you have made, or, in all probability, you ever will make, in all your life. Talk of 10 per cent annually. It will, many days, pay you 100 per cent daily.

Young men in foil clubs at Omaha have doubled their income from their operative dentistry since they have been using gold foil. Their greatest increase has been in Class 1 cavities and protective fillings which they were either overlooking or filling with amalgam or inlays.

CONCLUSION

There is no quarrel between the inlay and the foil worker. There can be none. Their fields do not overlap. The line of demarkation is quite clearly drawn. As previously stated, the operator, when he applies the dam, may not know which will be the better, but when the cavity begins to approach completion, one technic will, in most cases, stand out as having distinct advantage over the other. Occasionally, a cavity could be filled with either foil or inlay with very good results.

Class 3 cavities usually call for foil. The use of any other material is a compromise. For esthetics, we resort often to other materials, but we never should turn to the cast gold inlay for this reason. To make cast gold inlays in Class 3 cavities is to throw over most of what we have learned during fifty years in cavity preparation and dental histology.

Class 1 cavities, after the patient is 12 years, should, when the cavities are small, be filled with foil. Amalgam is the next choice; cast gold inlays should never be used. After the cavity becomes large, the cast gold inlay is, in most cases, the choice. Class 2 cavities, in the early stages of decay, usually call for foil in all the bicuspids and the mesial surface of the first two molars, both upper and lower. In Class 5, we find foil the material of choice in the majority of cases.

Many operators served their patients faithfully and well with foil and amalgam before the advent of the inlay. I regret to say many are attempting to serve them today without foil. To fall back to the old custom of using foil and amalgam only would be a great mistake. To attempt to practice operative dentistry without foil is equally bad.

We need foil; we need amalgam; we need the cast gold inlay; we need the porcelain inlay; we need the silicates, and the greater and ever present need is for that rare judgment to decide where each is indicated, and after that decision is made, the crowning need of them all is the ability to handle each one of them well.

Gold foil offers the one means of filling a cavity with a material that will not change in volume as the plastics do. It requires no cement to fill the dentinometallic space. It wears away evenly with the enamel. It has no margin, being sealed with a material which is both permeable and soluble.

Consider the advantage that gold foil holds in completing an operation at one sitting, under one application of the dam. Consider the protection of the patient against possible infection from hands, instruments or materials; against the accidental passage of the casting into the throat or lungs. Consider the safety of the operator from infection from the patient.

To have a good inlay, we have thought it necessary to have only a good cavity, good form, good contact, good occlusion and good margins; but now we know that we may have all these, and yet the

inlay will be only as good as the cement with which it is set.

The inlay calls for a comparatively new technic. Time will tell. The inlay will never dethrone foil as long as cements remain the poor materials that they are. Take a piece of cement that has been in the mouth for some time and hold it in a flame; see it carbonize and smell the gas. We remove few inlays that show cement of good color. A very large percentage have failing margins, and black cement shows to what extent they were failing. If the inlays that we made ten years ago were all removed and examined, what percentage do you believe would be considered good?

Many failures with both inlays and foil are chargeable to slothful operators. A good cavity may be wholly lost by having a poor casting placed in it, and, by the same token, a good cavity may be poorly filled with foil, the operator failing to adapt his material properly to the walls. He may use too much force, thereby checking the walls; or he may use insufficient condensation, rough, pitted gold resulting, so soft as to admit moisture all through the body of the filling.

Any of these results cannot, in justice, be charged to the materials.

The real bone of contention in this discussion does not lie in these common causes of failure. It is rather in the possibilities of the two technics. In other words, which in the hands of a good operator, equally skilled in the two methods, will produce the better result?

Each has been used extensively; each has been used by good operators, and each has been used by poor operators. Each has made a record and each must stand on its record.

Neither Dr. Grunn nor myself would have you accept our opinions independently of these records.

I commend for your consideration the record gold foil has made. I ask you to consider the inherent weakness of a "cemented operation."

I ask you to fracture the teeth you extract in which inlays have been placed, and to examine the walls and the cement. In comparison, I ask you to do likewise with teeth that were filled many years ago with gold foil, and to examine the walls and the margins.

Finally, let me commend to you a renewed interest in the use of gold foil in those cavities where it is manifestly indicated. If you will, I venture the opinion that you will find it, as scores of others have, the greatest of all materials in those cardinal properties that go to assure enduring operations, preserving pulp vitality and dental health and thereby contributing in no small degree to the well-being of mankind.

GOLD FOIL VS. GOLD INLAY*

By ALBERT P. GRUNN, D.D.S., Chicago, Ill.

WHEN William H. Taggart gave dentistry the cast gold inlay, he did more to lessen the burdens of the dentist and improve the quality of his work than any other inventor in the history of the profession. The casting art has revolutionized dentistry, making it possible to save teeth that were formerly crowned or lost. It has created in the minds of dentists and technicians ideas never possible before Dr. Taggart's invention. If ever there was a man in dentistry who deserves to have a monument erected to his memory, surely it is William H. Taggart. For it is he who delivered the dentists of the world out of the slavery of the gold foil method of filling teeth, making it possible for many men to continue on in practice who otherwise would have been obliged to quit, under the old back-breaking gold-foil method of filling teeth.

Exponents of the gold inlay have no quarrel with the advocates of gold foil, for, in the final analysis, we must admit that each has its place. The skill required to prepare a cavity for gold foil is no greater than that required for a good gold inlay; and, in my opinion, a properly prepared cavity for the insertion of a good gold inlay, so prepared as to permit the removal of a wax pattern without distortion, requires more skill than one prepared for a gold foil filling.

When the cast gold inlay method was first introduced, it spread like wild-fire throughout the profession, and it has continued to grow in popularity, in spite of the efforts of advocates of gold foil to discredit its use and to revive their pet method. It simply cannot be done: inlays are here to stay.

About nine out of ten students, on graduating from school, no matter how thoroughly they have been trained in the art of making gold foil fillings, will, almost immediately, turn to inlay making when they begin practicing. The reason for this situation can best be explained by quoting C. N. Johnson[1]:

> Why are we today presented with the spectacle of the almost total eclipse of the gold foil in the dental firmament? Why do we find men who will admit, or claim, they never use gold foil? In view of the acknowledged service of foil in the past, the present tendency is something to be taken into consideration.
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> Something inevitable has entered into the situation which cannot be ignored. The introduction of the gold inlay, rightly or wrongly, came near sounding the death knell of the gold foil. In looking into the reason why inlay work came so near eliminating the foil from dental practice, we will discover several contributing factors, and at least one of these takes us out of the profession.
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> No consideration of the subject is complete without facing the sublime entity known as our patients, and it is hardly stretching a point to say that our patients summarily took

*Read before the Section on Operative Dentistry at the Midwinter Clinic of the Chicago Dental Society, Feb. 4, 1931.

1. Johnson, C. N.: Value of Gold Foil in Modern Practice, J. A. D. A., 15:2051 (Nov.) 1928.

the matter out of our hands by waving foil aside and beckoning inlays in.

The outstanding limitation of foil is the hardship on the patient. Once a patient has enjoyed the pleasant experience of having a large inlay placed, he will never again submit to a gold foil. The rubber dam, ivory clamp and separator, sore tooth and tired jaw are out of the picture forever as far as he is concerned.

The gold inlay can be successfully used in more cases than can any other filling material. In 1905, there were no gold inlays. Since that time, there have been millions of gold inlays inserted, and it is quite apparent that they have taken the place of the gold foil. The inlay has replaced thousands of old amalgam fillings. The sale of gold plugger points and automatic pluggers has dwindled to almost nothing.

There has been a tremendous sale of not only inlay golds, but also waxes, investments, burning out devices, wax expanders, casting machines and investment mixers; and, throughout the country, study clubs and dental societies have demanded the services of inlay clinicians to teach them the latest technic in the inlay casting art.

The largest manufacturer of gold foil in the country reports a tremendous falling off in the sale of foil during the past twenty-five years, in spite of the increase in the number of dentists and number of people having restorative work done.

We hear of the greater loss of tooth structure in cavity preparation for a gold inlay than for a foil filling. With the high degree of perfection in the development of the present day inlay technic, there is little, if any, difference in the displacement of tooth structure in cavity preparation.

It is with some hesitancy that I mention the receipt of a greatly increased number of invitations from dental societies and study clubs all over the country for more information on inlay procedure. I do so merely as further evidence of a greater desire on the part of the profession to become more capable in this indispensable branch of dentistry.

The quality of work is improving each day, and it is safe to say that the number of expert inlay men is far in excess of that of expert gold foil operators.

Not only has the cast gold inlay saved millions of teeth: it has also made it possible to rebuild the tooth to its natural contour with cusps, pits and fissures, to build contacts rounded as Nature intended, to place fixed bridgework with inlay abutments and to place removable bridgework with attachments soldered, or cast, in inlays, all of which were unheard of before the introduction of the cast gold inlay and impossible in gold foil restorations.

If every dentist would examine his inlays before setting with a pair of binocular loupes, he would discover why many inlays did not go to place and why a cement line shows. Nodules, too small to be seen with the naked eye, would be disclosed, and which, if removed, would permit the seating of the casting exactly where it belonged.

Granted that foil fillings are indicated in the approximal surface of anterior teeth and in pit and fissure cavities in bicuspids and molars, how many patients in this day and age will permit a dentist to place a foil filling in an anterior tooth? The patient would much prefer a synthetic filling, even if it has to be replaced at frequent intervals, than to have foil, which so many times looks like a spot of decay.

We hear of cement lines around inlays. If a dentist understands cavity prepara-

tion and wax control, and has any knowledge of the wonderfully fine technic that has been developed, he should never have a cement line showing around a gold inlay.

What is wrong with gold inlays? you might ask a foil worker. Certainly, no fault in the operative procedure or technic. Stones, chisels, disks and, in fact, everything that makes for good operating are used in this work. We find men all over the United States who have developed a very fine inlay technic and are recognized as the finest operators in the country.

It was my good fortune to learn cavity preparation and foil filling under the tutelage of G. V. Black. On taking up the practice of dentistry, I was fortunate in being associated with Charles P. Pruyn, one of the ablest gold foil workers that dentistry has ever known. I used to see this man stand over a patient, pounding in foil hour after hour, day after day, and I wondered how long it would be before he succumbed to the terrible strain he subjected himself to. Many of you know what happened and that his was a sad ending of a brilliant student and operator, who gave up his life to the cause. Would that there were more men with as much skill!

When the inlay was introduced, I made up my mind to build a better gold inlay than a foil or not do inlay work at all. In this I succeeded, and I was soon making inlays without a trace of a cement line, and, incidently, making a better filling in the majority of cases than any foil filling that I could personally make. In those days, our casting technic was in many ways crude as compared with the 1931 methods.

My first casting machine consisted of a barn door hinge and a wet asbestos pad. Since that time, many casting devices, investment materials, waxes, etc., have been tried out by the profession and the peak has not been reached yet, because, with every man doing inlay work, no matter how nearly a perfect casting he makes, he still hopes to improve the next one. Much is being done in research on the expansion of waxes and investments, to compensate for the shrinkage of metal when cast. Many fine technics have been developed to such a high degree of perfection that if a dentist cannot make a good inlay today, it is his own fault.

In the practice of dentistry today, there should be but one thought in the mind of every dentist: "How can I best serve my patients?" Taking into consideration the fact that we are living in a fast moving, nervous age, we should aim to subject our patients to as little pain as possible, considering their health at all times, making short appointments and, in every way, making dental care as easy as possible. With all these things in mind, doesn't it seem logical that wherever it is possible to place an inlay, we are saving our patients and also saving ourselves a lot of nervous energy, which is always expended in the placing of the gold foil filling?

Soon after being asked to defend the gold inlay at this meeting, I began to make a canvass of the dentists locally to ascertain just what the proportion was of foil fillings to gold inlays placed in their respective practices. Out of more than 100 men questioned I found but one who placed more foil than inlays. The other ratios ran anywhere from 10:1 to as high as 1,000:1. One man said he had not placed a foil since the gold inlay was introduced and many claimed they had not placed one in years. So much for my local survey. Not to be satisfied with the consensus of opinion among local dentists,

I decided to go outside Chicago and obtain an opinion on this subject from dentists all over the United States. The questionnaire which was mailed to forty-seven outstanding dentists (one in Chicago), whose names were given me by the American Dental Association, read as follows:

Question 1. What in your opinion is the advantage of the cast gold inlay over the foil filling in the modern practice of today? And why?

Question 2. In your practice what is the proportion of the inlay to the foil filling? And why?

The answers to these questions are interesting.

Arthur D. Black, Chicago:

1. In my judgment, the principal advantage of the gold inlay over gold foil is the opportunity afforded to very exactly restore proximal contacts of proper form in the bicuspid and molar regions and thus protect the tissues which support the teeth. Why? Because the inlay may be built and trimmed to the best contour before it is cemented to place.

2. During the year 1929, I placed the following gold foil fillings and gold inlays. (See tabulation.)

Class of Cavity	Gold Inlays	Gold Foil
1 Pit and fissure.....	3	57
2 Proximoclusal in bicuspids and molars.	231	7
3 Proximal in incisors and cuspids	4	32
4 Proximo-incisal	1	0
5 Gingival thirds	0	10
	239	106

Why? Class 1. It is my practice to use gold foil or amalgam in pit and fissure cavities, unless the teeth have been neglected and the cavities are very large. Practically all of my adult patients are in for examination twice a year and children three or four times a year, so that I seldom fill a large cavity of this type.

Class 2. I prefer the gold inlay because of the better opportunity afforded to restore proper contact and occlusal form, also because of easier operation for both patient and operator.

Class 3. I prefer gold foil in all cases if the cavity is discovered when small, so that there will be no objectionable showing of gold.

Class 4. Both gold foil and gold inlays are generally not used, for cosmetic reasons.

Class 5. I prefer gold foil to the gold inlay, except for an occasional unusually large cavity in a back tooth, because less depth of cutting is required.

James V. Gentilly, Cleveland:

1. In order to consider the advantage of the cast gold inlay over the foil filling, we must consider certain factors that are pertinent to both: (1) contour and carvings; (2) marginal adaptation; (3) comfort and time; (4) contact.

The contour and carving of the restoration are secondary in consideration; with the inlay, it is made in wax; with foil, it is irritating to the patient. In the modern practice, the inlay has practically reached the acme of perfection from the wax stage to the finished cast. Expansion and shrinkage have been controlled. With the modern type of casting, the marginal contour of the inlay practically eliminates the cement line, the chief source of criticism. If a dentist applies modern methods of inlay casting, this bugaboo is gone. I have had many a foil filling develop a soft spot at the margin after it has been polished. It is needless to mention the time-saving element as between the two, the comfort to patient and operator when inlays replace foil and the nervous strain the operator is subjected to while inserting a foil filling. Contact with the adjacent tooth is an important consideration in a discussion of these two types of fillings. In a foil filling, prolonged and painful separation is necessary, whereas, with an inlay, it is but momentary.

2. Foil fillings in my practice are few. I would say about one out of fifty gold restorations is a foil filling, and it is usually employed in fissures and pit cavities, either on the buccal surface of bicuspids and molars, or, on the lingual of all teeth.

Edward T. Tinker, Minneapolis:

There is a great deal to be said on this question. Take the small filling, for example. The question of personal equation enters into it largely, and if fillings and inlays are

executed with an equal degree of skill, I do not see much difference. For larger restorations, to my mind, the argument is all in favor of the inlay, as it must be admitted that teeth can be saved with an inlay that are well-nigh impossible of restoration with gold foil. And I firmly believe that teeth are not nearly so traumatized in the placing of an inlay as they are with a gold foil filling. In my practice, I rarely employ a gold foil filling.

George W. Wilson, Milwaukee:

The greatest advantage of the gold inlay over gold foil in the modern practice is, I believe, the conservation of time in making large restorations. There is also a conservation of energy on the part of both operator and patient. The inlay can be used to advantage wherever the placing of foil would overtax the patient and the operator because of the size of the restoration. The inclination in this modern day is definitely directed toward ease in dental operations, and, in this respect, the gold inlay has a distinct advantage.

2. In my opinion, the proportion of inlays to gold foil fillings made in the average practice is about 50:50. Foils are used whenever possible in pits and fissures and simple approximal and gingival third cavities. Inlays have the preference in all other cavities.

John T. Hanks, New York:

1. Whether I would choose a gold inlay or a gold foil filling depends on the size of the cavity. The smaller the cavity, the more frequently I would use gold foil, as preparation for gold foil does not require so much cutting away of tooth substance as would be necessary in preparation for a gold inlay. On the other hand, it is self-evident that, in larger cavities, the gold inlay conserves the energy of the operator and restoration is not so disagreeable for the patient.

2. My practice being largely with adults, I probably use three or four times as many gold inlays as I do gold foil fillings. If I had a larger number of youthful patients, the proportion would probably be reversed.

Charles E. Burt, Los Angeles:

1. The advantage of the gold inlay in modern practice lies in the fact that more teeth can be fully restored anatomically with less strain on the patient and operator. By advanced technic in preparation of cavities, there is a minimum sacrifice of tooth structure, and in the proper alloying of gold, the maximum stability for contact and occlusal stress.

2. The percentage of gold-foil fillings employed in my practice is very small, their use being almost limited to cases that may be safely accomplished without the use of the rubber dam. Personally, I would not submit to long operations with a rubber dam over my teeth and I come in contact with few patients who would.

Mark D. Littig, Boston:

I use no foil, but frankly admit that there are many cases where it should be used in preference to inlays. I believe in the use of foil even though I have not used it for years.

Alfred Walker, New York:

In my practice, I use gold foil in occlusal cavities, in carious pits and carious fissures in developmental grooves, in gingival third cavities, in anterior teeth, in bicuspids and in anterior proximal cavities. For mesioclusal, distoclusal and mesioclusaldistal cavities in bicuspids and molars, I use inlays. I believe that the gold foil filling skilfully placed is the filling *par excellence,* but comparatively few operators have developed such a high degree of skill in the use of gold foil as to be enabled to meet all the demands of a satisfactory restoration with that material. I limit my application of gold foil to those cavities in which I believe I can place a satisfactory filling. My conception of a satisfactory filling is one that complies with the requirements of anatomic reproduction and that gives reasonable promise of permanency. While I do not feel disposed to make an arbitrary statement as to the relative merits of the gold foil filling and the gold inlay, I believe that we should be guided in our choice of method by what our individual experience has taught us will, in our hands, best serve the patient. Of course, permanency is a more or less relative term. Would it be remiss for me to mention here that very recently it became necessary, because of attritional wear at the cavity margins, to remove an inlay that I had placed in 1907? As there was no sign of decay anywhere, the inlay could rightfully be considered a satisfactory filling. To be sure, many of my inlays have had much shorter lives, but I do see many of my own, as well as those of others, that have endured for many years. So with gold foil: I have two

small gold foil fillings (proximal) in my central incisors that have been in place just thirty-five years, with no sign of a break. The inlay has advantages which should be mentioned. In the hands of many men classed as good operators, it makes a more satisfactory restoration than would a gold foil filling in the same hands. Under the same conditions, it shortens the time in the chair and is less fatiguing to the patient. On the other hand, gold foil frequently requires less sacrifice of tooth structure. This is my reason for employing it in small occlusal and gingival third cavities and in fissures. I should say that my proportion of inlays to foil fillings is nearly 1:1, with possibly more inlays placed. If I were as good a foil operator as Dr. Prime, I would make more foil fillings, but I would still find a place for the inlay.

George Hillias, Kansas City, is 90 per cent for the gold inlay, but prefers not to be quoted.

C. G. Parker, Detroit:

In my practice, I discontinued the use of gold foil fillings many years ago, I do not think I have malleted a foil filling in fifteen years. In my opinion, the inlay has these advantages over the foil filling: 1. The inlay is more dense than any foil filling could be. 2. It is much easier of insertion for both operator and patient. 3. In the bicuspids and molars, where 99 per cent of my gold inlays are inserted, any cavity can be prepared and an inlay set with no more sacrifice of sound tooth structure than would be required for a foil filling.

In fissures in bicuspids and molars, inlays as narrow as 18 or even 20 gage wire can be made successfully by the indirect method and with much less inconvenience to both patient and operator. In very small approximal cavities in the six anterior teeth, synthetic porcelain used with the proper care and attention to detail of preparation and insertion is much more acceptable to the patient as a rule, and, in pinhead cavities in any tooth, I find that synthetic porcelain gives most satisfactory results, showing no deterioration after several years.

Frederic R. Henshaw, Indianapolis:

1. The cast gold inlay as constructed according to modern principles and detail of technic, both in cavity preparation and mechanical production, has an advantage over the gold foil filling in application to compound restorations in the molars and bicuspids, for two reasons: (*a*) There is tremendous reduction of strain and stress, both physical and mental on the patient and the operator as well. (*b*) In the hands of the average man, a more nearly perfect restoration of the anatomic form of the tooth can be produced with a cast gold inlay than with a gold foil restoration.

2. In my own practice, I have practically abandoned the use of gold foil for compound restorations in molars and bicuspids. I believe that no material is equal to gold foil as a means of restoration for all proximal cavities in the incisors, and this may apply to certain cavities, including the incisal angle. For all simple Class 1 cavities in molars and bicuspids, I still use, with the utmost satisfaction, soft or noncohesive foil.

T. W. Maves, Cleveland:

1. Gold inlays can be used as abutments in all modern bridgework; can replace badly broken down teeth where cusps and angles are involved; enable the operator to restore occlusion by both direct and indirect methods; cause less discomfort to patient and operator; enable the operator to reproduce more nearly the lost part of the tooth, and permit the use of either soft or hard golds as demanded by the case.

2. In my practice gold foil is used only for some gingival anterior cavities and a few small approximal anterior cavities.

J. Franklin Cook, Los Angeles:

1. The gold inlay has the advantage in large restorations in the posterior portion of the mouth, with our accurate methods of cavity preparation and casting making it less inconvenient and more comfortable for the patient.

2. In the anterior portion of the mouth, I use porcelain inlays, and in all large restorations, jacket crowns. In small restorations, in both the anterior and posterior portions of the mouth, I use malleted gold foil, as I find that I sacrifice less tooth structure. As far as lasting, I find that the inlay, either gold or porcelain and the malleted gold foil make equally lasting restorations. Inlays are used in preference to gold foil 20:1.

Frederick J. Wolfe, New Orleans:

1. From twenty-two years of observation in my own practice, I would say that with gold inlays there is the possibility of better proximal contact and reproduction of tooth

contour. Also, the toughness and tensile strength of casting gold as prepared today allows us to maintain better contact and contour of the normal tooth outline.

2. I use approximately fifty gold inlays to one foil filling. I can get better and quicker results, especially in two surface fillings, using foil only in pit and fissure cavities.

Max Giesecke (Smedley Dental Group), Denver:

1. In the majority of cases, I believe the inlay preferable to the foil filling. We use foils in small Class 1 cavities not involving cusps, Class 3 which do not involve too much of the labial surface and Class 5 except in upper anterior teeth, in which we use porcelain inlays. In all cavities requiring extensive restorations, we prefer gold inlays. We feel that they are easier on the periodontium, take less time and give good service. A gold inlay may be contoured with greater ease and accuracy and with more assurance that the occlusal stress will be in harmony with the opposing teeth. If hard gold is used, there is less chance that the flow of gold will split a cusp.

2. In our practice, we make about ten inlays to one foil filling, because, whether we use foil or cast gold, our aim is to do what is best for the tooth.

I would much rather have an inlay inserted in my own tooth than to subject the peridental membrane to the percussion of a gold plugger.

John C. Mortonson, Milwaukee:

1. There is no quarrel between the cast gold inlay and the gold foil fillings. Each has found its place in the practice of dentistry, and where a cast gold inlay is indicated, it is a far better filling than the gold foil. In the small cavity, the gold foil filling still has its place. Undoubtedly there are men, especially among the older foil experts, who still believe their gold foil filling to be the best even in large cavities. In their own case, there is no question that they are right; but, in the hands of men who have become trained to put in a good cast gold inlay, I believe this type of filling to be superior to the foil filling; I mean in such cavities as the mesioclusodistal and such larger fillings. To my mind, there should be no question of any advantage of one over the other, each having its place.

2. In our practice I would say that we place at least eight or nine inlays to every foil filling, simply because in the cavities that we place them in we are able to make better inlays than foil fillings.

C. Victor Vignes, New Orleans:

I have not used gold foil in over eighteen years. A properly prepared cavity requires an inlay.

Charles S. Tuller, New Orleans:

1. The inlay has done more to keep people coming to the dental office than any improvement that we have made in dental service. One has but to listen to the lament of old patients who describe the disgusting rubber dam, the endless pounding, for as much as three hours at a time, the sore tooth and the heat generated in polishing, along with the gum laceration. There would not be nearly the number of patients nor so much dentistry done today if we were still pounding gold. The most accomplished operator could not always put in perfect fillings, and what a tragedy when we discovered an imperfect margin after polishing. Did you have the courage to tell the patient then, or did you wait until the vandal hand of time had done its worst?

Others will touch on the technical points, such as perfect contact points and carved occlusal surfaces, etc., but I will dwell only on the humanitarian side as being of paramount importance. We can do sufficiently good dentistry with the inlay to meet the needs of the patient. I have patients wearing inlays in perfect condition after twenty years, and those were crude as compared to the castings of today. The inlay meets the need with the least cost in time, effort, patience, fatigue, pain and comfort.

One hundred per cent of the fillings placed in my office are inlays.

Edouard M. Hall, Kansas City:

1. With the cast gold inlay, larger proportions of tooth can be restored with less injury to the dental pulp and peridental membrane and less discomfort to the patient than is possible with gold foil. The approximating contact points can be better restored with inlays than with foil fillings. Gingival cavities can be filled with inlays where it is impossible to place gold foil because of inability to keep the area dry long enough to place a foil filling. With the information that is being worked out by our research fellowship at the National Bureau of Standards in cooperation with groups of dentists all over the country, I feel quite sure that the value and usefulness of

the cast gold inlay will be much enhanced if the "rank and file" of the profession can be induced to correct their technic to meet the requirements as developed and made plain by these researches.

No discussion of cast gold inlay reconstructions should fail to give careful consideration of and warning against the selection of some of our modern hard golds for filling material where they will cause unbalanced occlusion and trauma to restored teeth because of their failure to "wear down" in proportion to the rest of the teeth.

"Traumatic occlusion" is a subject greatly overstressed by many men today, yet it must, or should, receive proper consideration. I am convinced that most inlays should be cast from pure gold or gold of not less than 22 carats.

2. In my practice, I place more foil fillings than inlays because I am making every effort to "rule with force," to have my patients report often for prophylaxis and inspection and thus discover and correct cavities before they are large, and where these are accessible and operable for foil, that is our choice. Why? Pure gold is the only metal restoration that approximates the "wearing down" of natural teeth.

Herman E. S. Chayes, New York:

I note the questions which you asked in this letter and in reply, may I be permitted to quote you the definition for a cast gold inlay which I read at a meeting of the Illinois State Dental Society in 1912: "A cast gold inlay may be defined as a mass of molten metal which under definite gaseous pressure, is forced into and shaped in a special mold so that it will, upon cooling or crystalization, accurately fit into the cavity of the tooth from which the wax pattern embedded in the mold was taken, and that cool mass of metal shall in outline and eminence so conform to the outlines and eminences of that particular tooth and opposing and adjoining teeth, if there be any, that it shall form an acceptable anatomical complement to the tooth requiring the restoration, and that it shall make that tooth macroscopically perfect. In short then, a cast gold inlay is an accurate metallic complement to the macroscopic anatomy of a broken down tooth."

It must be obvious from the foregoing definition that one of the reasons for the widespread interest in cast gold inlay work is the difficulty of attaining the ideal result in the restoration of broken down teeth by the gold foil method. In my experience of about thirty years in filling different teeth with different materials, I am willing to be quoted as asserting that no compound or complex cavity in a tooth can be made as macroscopically acceptable with gold foil as it can with a cast gold inlay process, except it be a cavity that is so easily accessible that the various difficulties would, because of the accessibility, be eliminated to the minimum. It is difficult to conceive how a large gold foil restoration may be made by malleting the gold directly into the tooth, without definitely and, in my opinion, permanently violating the integrity of the pulp or peridental membrane.

The process of condensation required for thorough homogeneity of the filling necessitates thousands on thousands of definite strokes or blows on that gold against the tooth. Or, if noncohesive foil is used, the packing process necessitated by the quality of the material used will exercise an enormous amount of pressure against the tooth substance. This will also definitely injure the pulp and peridental membrane as evidenced by many so-called "lame teeth" associated with foil work in cases of large restorations.

It is a difficult matter to finish to proper contour and with perfect freedom from roughness the dental surface of any malleted filling distally from the second bicuspid; whereas, it is a comparatively simple matter to finish to perfect smoothness the surface and margins of a properly constructed inlay.

The most ardent advocate of gold foil fillings will have to agree that the production of occlusal surfaces, correct and acceptable to the opposing and adjacent teeth is a most arduous process in gold foil fillings; whereas, it is a comparatively simple process in the cast gold inlay.

Everything which we do requires an adequate and carefully worked out, as well as carefully followed technic in all its details, and, considered point from point, the cast gold inlay, when properly constructed, makes a more acceptable restoration for the average broken down tooth than the skilled operator can produce with the gold foil method.

It is true that, in marginal fit between tooth and metal, the laurels must go to the malleted gold foil filling wherever accessibility can be obtained. In our practice, the malleted gold foil filling is limited to small

occlusal cavities in the posterior teeth, mesioclusal cavities in the upper and lower first bicuspids and small pit cavities in the lingual surfaces of the six anterior teeth. We confine ourselves to porcelain or silicate in proximal cavities of all anterior teeth, as well as in interproximal cavities of first bicuspids.

Thomas P. Fox, Philadelphia:

1. The gold inlay is preferred to gold foil because of ability to carve and reproduce the missing parts with greater accuracy; ability to reach the brush line without extensive cutting, as in the preparation for foil; ease of manipulation; decrease in actual time in the chair; certainty of secure margins; minimizing of danger of injuring enamel rods on the cavosurface margin by the automatic plugger; ability of inlays to cover weakened enamel walls; consistency of density in all inlays; lessening of fatigue to the patient.

2. The proportion is approximately five inlays to two foil fillings. The main reason for this is that I have mostly an adult clientele and the caries generally involves two surfaces. These compound or Class 2 cavities, I fill with gold inlay. Where there are pits and fissures, I make a practice of using gold foil.

S. S. Grosjean, New Orleans:

In my early practice, I placed a considerable number of foil fillings. At present, the foil filling is confined to pits, small fissure and incisal cavities. In small shallow cavities, a better retention is possible, and the operation more expeditiously accomplished.

2. Inlays are used in all other restorations where gold is indicated. Inlays are easier to manipulate and more rapidly handled, with much less discomfort to the patient. Alloy golds can be used, insuring a harder restoration. Larger restorations which are more practical can be made. The contact point is restored to better advantage. Separating of teeth to obtain results is unnecessary. A greater variety of cavities are possible in preparation and, in many instances, a type in which foil could not be used. There is greater tensile strength and, very often, surfaces can be protected by overlapping and the tooth be prevented from fracturing. More accurate anatomic carving is possible, and carving can be done with greater ease. A thin layer of cement assures not only retention but also insulation.

I believe I have enumerated enough to convince you that I am 100 per cent for inlays.

Albert L. Legro, Detroit:

1. Assuming that preparation and fillings are perfect, I would say that, aside from the lessened discomfort to the patient, the advantage afforded by hard golds that more nearly simulate the strength and density of the enamel is paramount. Pure gold is very acceptable to tooth tissue, more so than any other metal, but it acts merely as a stopper of the cavity and does not restore occlusal surfaces accurately and permanently.

Cement is one of the best tooth preservatives and, when it remains intact, absolutely prevents further decay and is more acceptable to vital tooth tissue. I would say that this is an equally important argument in favor of the cast inlay. An inlay of any sort is but a cement filling protected by the inlay itself for a long life of usefulness.

A disadvantage of the foil filling in the hands of the average operator is cavity preparation that admits (though not always practiced) of undercuts, allowing a filling to remain in a cavity long after its life of usefulness is ended, permitting much harm to come to surrounding tooth tissue.

The foil filling is incapable of an accurate occlusal construction that remains permanent under the stress of mastication, placing the burden of wear and stress on the surrounding tooth substance instead of assuming its share.

2. The number of foil fillings made in my practice by three operators will not reach thirty each year, which is probably 4 per cent of the gold fillings inserted in this office. The answer to Question 1 gives the reason. We employ foil only for very small approximal cavities in anterior teeth and for pits and decayed sulci that do not justify excavation enough for inlays.

In answering Question 1, I have refrained from giving the stereotyped and recognized reasons such as time, comfort to patient, etc., which are generally recognized as factors in favor of the cast gold inlay.

Edward H. Bruening, Omaha:

1. The cast gold inlay has the advantage over gold foil in cavities where loss of tissues has weakened the wall or endangered the pulp; where access is difficult; where the investing tissues are impaired to such degree that malleting foil would be painful, and in the case of nervous patients or old people;

because there is more danger of fracture or pulp involvement in the use of gold foil; the correct line of force is essential in malleting foil; the mallet force irritates these tissues, and short operations are preferable in these cases.

2. Approximately 55 per cent of fillings employed in my office are gold inlays; 35 per cent, gold foil; 10 per cent, other materials.

C. C. Sparrow, Minneapolis:

1. The cast gold inlay has a greater range of usefulness than the gold foil filling. A better contact point can be made with the cast inlay and it can be more easily and properly placed, to say nothing of the contact form. Occlusal carvings in posterior teeth can be made out of the mouth, time being thus saved to the operator and annoyance to the patient. Much larger restorations can be made on badly broken down teeth, with a better chance for future usefulness. The rubber dam can be done away with and the operation can be done with much less expenditure of nervous energy to the patient. This is important in this age of highly developed and overworked nervous systems. The use of the finishing strip is practically done away with, which lessens the chances of serious injury to the interproximal tissues.

2. In my practice, the gold foil filling is practically ruled out for the reasons given above.

Amos Irving Hadley, Boston:

Of course, these questions refer to the rank and file of dentists, commonly referred to as "average."

In medium or large restorations, the cast gold inlay not only saves tooth structure and supports frail walls, but also gives comfort to the patient. That, today, is the thing patients are the most interested in. The average cavity will take at least an hour to an hour and a half for proper preparation and filling with foil. To condense the gold properly, a considerable force has to be used. Oliver Wendell Holmes, in an address on dentistry many years ago, said, "The use of the mallet in filling teeth, every blow of which instrument, a fractional knock on the head to the patient, is equal to about one-hundredth of that which a slayer of cattle gives to a full-grown ox to finish him, but which, taken in divided doses, allows the sufferer to escape with life. Every man must be anvil or sledge, says Goethe, and it is quite plain that our friends, the dentists, have settled it so far as they and we are concerned."

After an hour or so of the foregoing treatment, is it a wonder that the tooth is sore and the patient and operator are nervous and on edge? This does not lessen the danger of chipping the enamel with the plugger point. After going through that strain, the filling has to be finished with burnisher, stones and sandpaper disks, which adds insult to injury. With the inlay (made with the indirect method), all of that nerve-racking treatment is avoided, as the filling is entirely finished before it is set in the tooth, it being unnecessary to touch the filling with either stones or disks, as all of that disagreeable part of the operation is done on the amalgam die, to the immense satisfaction and pleasure of the patient, as many have testified.

The inlay can be made to accurately reproduce the anatomic shape of the tooth, both approximately and coronally. Besides, in a year, or sometimes a few months, the surface of the inlay is not found full of little pits (or rat-holes so-called).

To secure a permanent and hard smooth surface on the foil filling, the malleting has to be even harder than Dr. Holmes described, which spells cruelty to animals. These pits are great harborers for secretions, etc.

In answering your second question, I would say that probably from 80 to 85 per cent would be the proportion of the inlays placed to the foil fillings. Of course, here we have always been more conservative than in other parts of the country. I plead guilty if offense is indicated. I will not cut a tooth just to insert an inlay. I feel that Dr. Black, like the Bible, should be respected, but should not be taken too literally.

Surely, in this survey, would it not seem that there is a preponderance of evidence supporting the inlay, which obviously must have a tremendous advantage over the gold foil?

We are living in an age of progress and invention, and, unless we keep in step with the times, we are apt to find ourselves at the tag end of the procession, driving a horse and buggy, while the other men are up ahead driving a sixteen-cylinder automobile.

INCIDENCE OF VINCENT'S INFECTION; CONCLUSIONS BASED ON A STUDY OF THREE THOUSAND SEVEN HUNDRED AND SEVENTY-ONE SMEARS AND CASE HISTORIES

By FRANCIS H. DALEY, D.M.D., Boston, Mass.

DURING the past four years, we have been examining the mouths of patients who presented themselves at the dental school clinic for general operative dentistry. The smears and case histories so obtained were taken at random from patients as they passed through the examining department of the clinic.

Smears were taken from any area of the oral cavity which showed pathologic changes in the tissues. Most of them were from the gingival area. In the mouths which were apparently free from such changes, we took smears from the gingival trough. During this period, we have obtained smears and case histories from 3,771 patients. The total number examined was well over 4,000, but it was necessary that many be thrown out because of poor smears or incomplete case histories.

In working in such a clinic as ours, it is natural to assume that the type of patient presenting will not be up to the standard of the patient who goes through the hands of the ordinary general practitioner of dentistry. We see more of the poorer class, who, either through ignorance, or through financial inability, are unable to give their mouths the hygienic care which they should have. We must expect to find a higher percentage of pathologic changes than would the average practitioner. This factor must be taken into consideration in order to evaluate the statistics properly.

Our classification of these cases, in respect to Vincent's infection, is as follows: positive, negative and potential. This classification has been explained in detail in another article on the disease.[1] Suffice it to say here that those classified as positive show clinical as well as microscopic manifestations of the disease.

These statistics have been compiled on a monthly basis in order that we may have some means of camparing the results, to determine what months or seasons show an increase in the incidence. We have also compiled statistics on an age basis in order to determine at what age individuals are apparently most susceptible to the disease. Our statistics show the total number of patients examined in each age group and the percentage of positive cases in each group. They also show the number of patients examined in each age group for both sexes, male and female.

It will be noted that the bulk of our case histories come within the period of October to June. This is due to the fact that we have been unable to continue our work during the summer months. It

1. Daley, F. H.: Vincent's Infection: Microscopic Diagnosis, J. A. D. A., 18:76 (Jan.) 1931.

has been my observation that the disease is much less prevalent during the period from June to September. In order to substantiate this opinion, it will be necessary to gather statistics from mouths examined during this period.

Our case histories show the number of cases occurring in native-born and foreign-born individuals. These figures have not been tabulated, but a cursory examination of the histories seems to show that the larger percentage of positive cases occur among native-born patients. We have also noted that the

TABLE 1.—GENERAL AGE INCIDENCE

Patients Examined	Ages Years	Positive Cases No.	Per Cent
30	00-10	8	(26.66)
390	10-15	83	(21.28)
582	15-20	161	(27.31)
1,233	20-30	434	(35.19)
687	30-40	267	(38.88)
476	40-50	175	(36.74)
245	50-60	64	(26.12)
128	60-70	44	(34.37)
			Per Cent
Total number of smears		3,771	
Positive		1,236	(32.77)
Negative		2,030	(53.83)
Potential		505	(13.40)
Marked throat symptoms		579	(15.32)
Marked malaise		513	(13.33)

majority of positive cases appear in individuals having occupations of a sedentary nature. Lack of exercise and faulty elimination are, of course, more common in this group.

It will be noted that a few months show a total number of case histories of less than 100. The reason for this is that many of the smears and histories for these periods were discarded as incomplete. We feel, therefore, we cannot draw definite conclusions for such periods. Because of this fact, we have made our analysis of these statistics, from a monthly or seasonal point of view, only upon those months which show totals of 100 or more smears and case histories.

Table 1 shows that the greatest general age incidence is within the period of from 20 to 50. It also shows that the highest percentage of positive cases come within the period of from 30 to 40.

Table 2 shows that the greatest general age incidence for both male and female is within the period of from 20 to 50. This sheet also shows that the highest percentage of positive cases among the males was in the period of from 30

TABLE 2.—GENERAL AGE INCIDENCE
(Males and Females)

Patients Examined	Ages Years	Positive Cases No.	Per Cent
Males			
15	00-10	4	(26.60)
178	10-15	39	(21.91)
308	15-20	86	(27.95)
810	20-30	269	(33.20)
288	30-40	118	(40.97)
202	40-50	72	(35.64)
134	50-60	35	(26.11)
83	60-70	27	(32.53)
Females			
15	00-10	4	(26.60)
212	10-15	44	(20.75)
274	15-20	75	(27.37)
423	20-30	165	(39.00)
399	30-40	149	(37.34)
274	40-50	103	(37.60)
111	50-60	29	(26.13)
45	60-70	17	(37.77)

to 40. The highest percentage of positive cases among the females came within the period of 20 to 30.

Table 3 shows that, in the year 1927, the first four months showed an average incidence of 34.35 per cent. The last three months of the year showed an average incidence of 30.66 per cent. The average incidence for the entire year was 32.66 per cent.

Table 4 shows that, in the year 1928, the first four months showed an average

TABLE 3.—AVERAGE INCIDENCE FOR VARIOUS PERIODS (1927)*

	No. of Smears	Positive No.	Positive Per Cent	Negative No.	Negative Per Cent	Potential No.	Potential Per Cent
January	461	143	(31.02)	246	(53.36)	72	(15.62)
February	299	106	(35.78)	152	(50.86)	41	(13.36)
March	350	110	(31.71)	169	(48.28)	71	(21.01)
April	141	55	(39.00)	68	(48.22)	18	(12.78)
May	80	30	(37.50)	42	(52.50)	08	(10.00)
June	...	...	....	...	....	..	....
July	...	...	....	...	....	..	....
August	...	...	....	...	....	..	....
September	11	06	(54.54)	04	(36.36)	01	(9.10)
October	174	67	(38.50)	88	(50.57)	19	(10.93)
November	153	59	(38.56)	75	(49.01)	19	(12.23)
December	174	26	(14.94)	125	(71.83)	23	(13.23)

		Per Cent
Total number of smears	1,843	
Positive	602	(32.66)
Negative	969	(47.14)
Potential	272	(20.20)
Marked throat symptoms	193	(10.47)
Marked malaise	139	(07.54)

*The totals for 1927 include the months of October, November and December of 1926.

TABLE 4.—AVERAGE INCIDENCE FOR VARIOUS PERIODS (1928)

	No. of Smears	Positive No.	Positive Per Cent	Negative No.	Negative Per Cent	Potential No.	Potential Per Cent
January	234	73	(31.15)	142	(60.68)	19	(8.17)
February	202	76	(37.12)	98	(48.51)	28	(14.27)
March	188	63	(33.51)	109	(57.92)	16	(8.57)
April	115	41	(35.67)	61	(53.04)	13	(11.29)
May	216	59	(27.31)	115	(53.24)	42	(19.45)
June	27	10	(37.03)	16	(59.25)	01	(3.72)
July	...	...	....	...	....	..	....
August	...	...	....	...	....	..	....
September	07	05	(71.42)	02	(28.58)	00	(00.00)
October	166	49	(29.54)	92	(55.41)	25	(15.08)
November	94	31	(32.97)	54	(57.44)	09	(9.59)
December	26	16	(61.53)	09	(34.61)	01	(3.86)

		Per Cent
Total number of smears	1,275	
Positive	423	(33.17)
Negative	698	(54.74)
Potential	154	(12.09)
Marked throat symptoms	280	(21.96)
Marked malaise	236	(18.50)

incidence of 34.36 per cent. Taking October and November of the same year, we find the average incidence to be 31.25 per cent. The average incidence for the entire year was 33.17 per cent.

Table 5 shows that January was the only month of the first four in 1929 to have a total of more than 100 histories. Using this as an average, we have 33.05 per cent. The last three months of the

year average 24.93 per cent. The average incidence for the entire year was 32.31 per cent.

CONCLUSIONS

1. Vincent's infection is most common in individuals between the ages of 20 and 50.

2. The most susceptible period among females is between the ages of 20 and 30.

3. The most susceptible period among the males is between the ages of 30 and 40.

4. Vincent's infection is more prevalent the first three or four months of the year than it is during the last three or four months. The average incidence for the first three months of the year is higher than the general average for the year. The average incidence for the last three months of the year is lower than the general average for the year.

5. Vincent's infection is more prevalent among native-born individuals than among the foreign-born.

6. Vincent's infection is more common among individuals having occupations of a sedentary nature.

7. During the past three years, there has been a definite increase in the percentage of "clean mouths."

416 Huntington Avenue.

TABLE 5.—AVERAGE INCIDENCE FOR VARIOUS PERIODS (1929)

	No. of Smears	Positive No.	Positive Per Cent	Negative No.	Negative Per Cent	Potential No.	Potential Per Cent
January	121	40	(33.05)	63	(52.04)	18	(14.91)
February	32	19	(59.37)	11	(34.37)	02	(6.26)
March	40	22	(55.00)	16	(40.00)	02	(5.00)
April	16	11	(68.75)	03	(18.75)	02	(12.50)
May	27	15	(59.25)	11	(40.74)	01	(00.01)
June	...	...	....	...	....	..	....
July	...	...	....	...	....	..	....
August	...	...	....	...	....	..	....
September	...	...	....	...	....	..	....
October	140	31	(22.14)	93	(66.42)	16	(11.42)
November	155	41	(26.45)	88	(56.77)	26	(16.78)
December	122	32	(26.22)	78	(63.93)	12	(9.85)
Total number of smears	653						
Positive	211		(32.31)				
Negative	363		(55.58)				
Potential	79		(12.11)				
Marked throat symptoms	106		(16.23)				
Marked malaise	138		(21.13)				

CLINICAL APPLICATION OF UNILATERAL BALANCE TO PROSTHETIC DENTISTRY*

By HUGH W. MAC MILLAN, D.D.S., M.D., F.A.C.D., Cincinnati, Ohio

BALANCED occlusion has always been synonymous with bilateral balance and three-point contact. The "opposite or balancing side" calls to mind a definite, clear-cut picture of the contact of the buccal cusp of the mandibular first molar of the balancing side with the lingual cusp of the antagonizing maxillary molar. (Fig. 1.)

In prosthetic dentistry, this conception of the relationship of the two dental

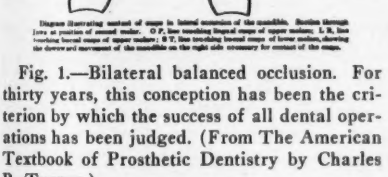

Fig. 1.—Bilateral balanced occlusion. For thirty years, this conception has been the criterion by which the success of all dental operations has been judged. (From The American Textbook of Prosthetic Dentistry by Charles R. Turner.)

arches has remained for more than thirty years the ideal toward which all effort has been directed. Throughout all the controversies regarding impression technic, vulcanite or metallic bases, articulators unnumbered, gum sections, anatomic molds, channel teeth and cuspless teeth, the theory of balanced occlusion has remained unchanged. "When the mandible is thrown to one side and brought in contact with the upper teeth, the lower teeth are in contact with the upper at three widely separated points." It has been claimed that this arrangement allows the muscles of "both sides" to exert a much greater force "than that which would result from the pull of only one set of muscles."

In an article entitled "Unilateral Vs.

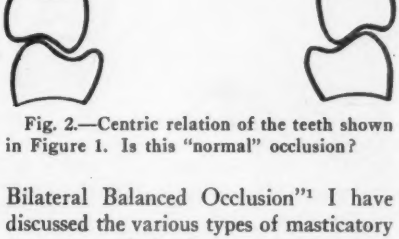

Fig. 2.—Centric relation of the teeth shown in Figure 1. Is this "normal" occlusion?

Bilateral Balanced Occlusion"[1] I have discussed the various types of masticatory excursions of the lower animals. Anatomically, it is impossible for the teeth of the lower animals to assume the relationship shown in Figure 1. In the pig, the movement of the mandible is orthal. There is no protrusion, no retrusion, no lateral movement; hence, there is no "bilateral balance" nor three-point contact. The characteristics of the carnivorous animals are hinged articulation, orthal

*Read before the Section on Full Dentures at the Midwinter Clinic of the Chicago Dental Society, Feb. 4, 1931.

1. MacMillan, H. W.: J.A.D.A., 17:1207-1221 (July) 1930.

type of excursion, no protrusion, no retrusion, no lateral movement, no "bilateral balance," no three-point contact. In the ox, there are no maxillary incisors, no cuspids; no three-point contact. The excursion of the jaw is of the ental type. When the teeth of the working side are in functional relationship, the teeth of the idle side are several millimeters apart, making "bilateral balance" or even bilateral contact impossible. The narrow mandible of the horse, with its ectal type of excursion, admits of no "bilateral balance." In the rabbit, characterized by an anteroposterior excursion (proal), the molars are far apart when the edges of the incisors come into occlusion. The great difference in the width of the upper

Fig. 3.—"Bilateral balance" in Figure 1 when the mandible is moved to the opposite side. This discrepancy shows the fallacy of attempting to prove theories by diagrams anatomically incorrect.

and lower jaws makes it anatomically impossible for the rabbit to chew on both sides at once. "Bilateral balance" and three-point contact are impossible in the rodent. The elephant, exhibiting the palinal type of masticatory excursion, has no mandibular incisors, cuspids or bicuspids, and hence no three-point contact. Because of the peculiar eruption of the molars, the wearing of the anterior molar out of occlusion, the arrangement of the teeth, and the postero-anterior movement of the mandible, there is no "bilateral balance."

There is no proof that "bilateral balance" or three-point contact is of any physiologic significance or that it affords any mechanical aid to masticating. On the other hand, there is a wealth of evidence indicating that mastication is fundamentally a unilateral process. In the lower animals, the muscles of mastication of each side work independently of those of the opposite side as far as any "balancing" assistance from the teeth of the opposite side is concerned. I claim that this is equally true in the human.

The muscles of mastication of one side, in the human being, are designed to move the mandible in a direction opposite to that produced by the muscles of the opposite side. On the right side, the direction of the excursion is from right to left; on the left side, the direction is reversed. It is a physiologic and logical impossibility for the food to be so equally disposed about the right and left molar regions that it would afford equal resistance to the muscles of both sides, even if the movement were purely orthal, which it is not.

"Bilateral balance" and three-point contact depend on the supposition that the cusps of the teeth pass through the bolus, come in contact, as in Figure 1, and are then carried in a direction from without in, the force being applied by the muscles of both sides. This relationship has been shown to be in error by motion picture studies of the teeth during mastication. The films show that the teeth, when chewing tough, resistant food, do not pass through the bolus. The teeth of the working side make repeated attacks on the bolus and do not come into close approximation until after the food is softened and fluidized. In persons having a normal occlusion, the buccal cusp of the lower molar of the working side is directed toward the central fossa of the

upper molars. Similarly, the buccal cusp of the mandibular molar of the opposite or idle side is directed toward the central fossa of the maxillary molar. The buccal cusp of the mandibular molar of the idle side never comes in contact with the lingual cusp of the maxillary molar. The relationship of the molars as is shown in Figure 1 is not functional relationship.

Peculiar habits of masticating, the loss of a tooth, accidents, the slightest mal-occlusion and the constant changes in cusp conformation due to normal wear destroy this imaginary ideal of "bilateral bal-

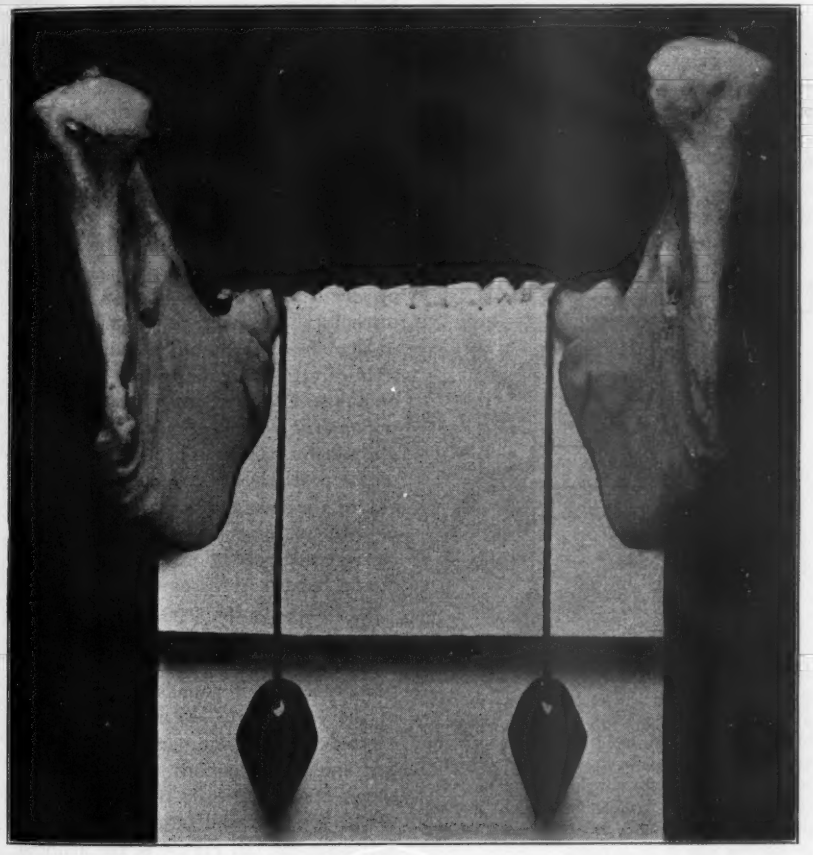

Fig. 4.—The relation of the lingual surfaces to the mylohyoid ridge in the second molar region. The recognition of this anatomic relation assists in securing the correct position of the lingual surfaces of the artificial molars in order to secure stabilization of the denture and consequent physiologic stimulation of the alveolar ridge.

ance." In a recent discussion on the coordination of occlusal surfaces, George M. Hollenbeck epitomized the subject in one apt sentence: "The more the individual uses his teeth, the more they are worn out of bilateral balance."

There is considerable evidence in favor of the unilateral conception of balanced occlusion, which will be merely outlined at this time: the differences in mensuration of the two halves of mandibles, due to unilateral development; the roentgenographic evidence of differences in bone structure of opposite sides; unilateral disuse atrophy; unequal wear of the teeth

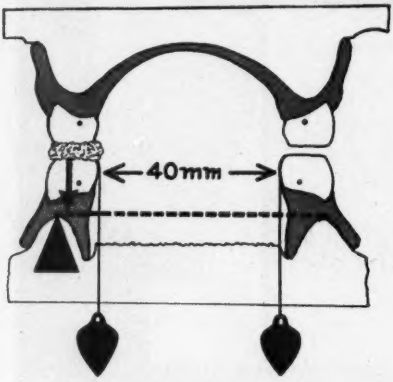

Fig. 5.—Diagram of the cartoon shown in the moving picture, "The Mechanics of Balance in Dental Prosthesis." The artificial mandibular second molars were placed the same distance apart—40 mm.—as were the natural molars before extraction. The relation of the plumb lines to the lingual surface of the alveolar ridges and the region of the mylohyoid line is to be noted.

of the right and left sides; the different amounts of force produced by the right and left groups of muscles of mastication as measured by gnathodynamometers; the difference in the outlines of the graphs made by the mandibular molars on the right and left sides in the same patient during functional excursion; the presence of opposing and antagonistic fasciculi in both right and left groups of muscles of mastication, making it possible for each group to maintain equilibrium without help from the opposite side, and the fact that the neurologic control of mastication is, for the most part, from two separate and distinct centers on opposite sides of the brain without the multiplicity of neurons connecting with the centers of the opposite side, such as are present, for example, in the muscles coordinating the movements of the eyes.

"Bilateral balance" and three-point contact have been sponsored chiefly by prosthetists in order to secure a supposed mechanical advantage in the stabilization of dentures. "Bilateral balance" is possible of attainment only with soft foods or fluids. The mastication of hard foods with a denture relying on the teeth of the idle side for balance is dependent, at best, on the principle of the seesaw. The analysis of the leverage in the molar region of artificial dentures affords one of the clearest methods of explanation of unilateral balance in the natural teeth.

In Figure 6, the crest of the alveolar ridge is depicted as the fulcrum. If the length of the power arm is 4 mm., the power exerted, 50 pounds, and the length of the weight arm, 40 mm., the weight exerted on the ridge opposite the working side is 5 pounds. The diagram shows how beautifully this arrangement works for the stabilization of partial or full dentures. In Figure 6, the artificial tooth which is of less diameter than the natural tooth occupies the same relative position on the artificial denture as in the natural denture as far as the location of the lingual surfaces is concerned. The location of the buccal cusp of the artificial tooth brings "the line of action of the load" medially from the fulcrum, thus

creating a lever of the third class. The denture is effectually stabilized through the pressure of the denture base of the opposite side—not the teeth of the opposite side. That this is as practical in its clinical application as it appears in the diagram has been attested by several competent prosthetists.

In the natural human denture, the buccal cusps of the molars are located directly over the fulcrum, which reduces to a minimum the leverage on the opposite side. The masticatory mechanism of the working side is in such perfect equilibrium that there is no need of any assistance from the teeth of the idle side. Unilateral balance in molar mastication is beautifully illustrated in comparative anatomy. The uncalcified symphyses of many of the lower animals show the lack of leverage through this region. This movable joint shows conclusively that power is not transmitted from one half of the mandible to the other in molar mastication.

The marked success of artificial dentures using "cuspless" teeth or any low cusped teeth when set in the relation shown in Figure 5 definitely disproves the theory, from a clinical standpoint, that "bilateral balance" is necessary in artificial dentures, since there are no cusps on these teeth to balance with those of the opposite side. I believe that the great success of the "cross-bite" tooth is due to the application of this theory of unilateral balanced occlusion and that the opposite or "balancing" side, as Gysi calls it, does not afford the reason.

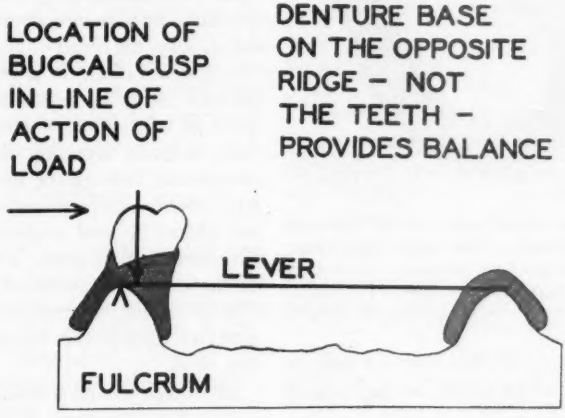
LOCATION OF BUCCAL CUSP IN LINE OF ACTION OF LOAD
DENTURE BASE ON THE OPPOSITE RIDGE – NOT THE TEETH – PROVIDES BALANCE
LEVER
FULCRUM

Fig. 6.—Mechanics of the cartoon shown in Figure 5. In order to secure stability, the "line of action of load" is directed at a point between the fulcrum and the resistance thereby creating a lever of the third class.

The theory of "bilateral balance" has never concerned itself with the relation of the molars to the mylohyoid ridge or with the stabilizing effect of the denture base of the opposite side. Stabilization of the denture has been taught to be dependent entirely on cusp relations of the teeth of the opposite or "balancing side." "Bilateral balance" is not mechanical balance unless the teeth are arranged lingually from the fulcrum. In prosthetic litera-

ture, there is no reference based on anatomic facts or principles of mechanics describing the exact position which the artificial mandibular molars must occupy in order to produce a physiologic stimulation of the edentulous alveolar ridge.

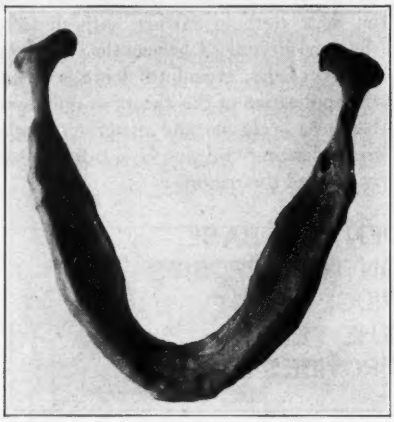

Fig. 7.—An edentulous mandible. The most constant landmark is the mylohyoid ridge. Imaginary plumb lines projected upward, as in Figure 4, suggest the location of the lingual surfaces of the artificial mandibular molars.

The measure of efficiency of a denture is the ability of the patient to crush a hard substance in the molar region of the working side without dislodging the denture. Dentures built on the principle shown in Figure 5 remain seated on the idle side while the limit of pressure is being exerted on the working side.

A denture which depends on "bilateral balance" with the buccal cusp set buccally from the fulcrum cannot stimulate the tissues physiologically, as, at best, during the actual breaking up of hard foodstuffs, the dentures cannot remain seated. The continuous absorption which progresses under these dentures is not due to trauma from overstimulation, not to injuries sustained by cusp interference, but to disuse atrophy, the result of insufficient functional stimulation. It is possible for the alveolar ridge to be stimulated, and it must be stimulated to preserve its contour, only by receiving the impacts of mastication through the agency of a denture which must remain seated during all the phases of food preparation prior to the comminution stage. The application of the theory of unilateral balanced occlusion to the construction of artificial dentures affords the means of securing this ideal.

1005 Union Central Building.

THE SIGNIFICANCE OF INSURANCE AND OTHER ECONOMIC DEVELOPMENTS TO THE DENTAL PROFESSION

By H. E. PHILLIPS, D.D.S., Chicago, Ill.

THE economic problems of the medical and dental professions have been the subject of widespread discussion, alike by the lay public and among professional men. This general interest led to the organization, nearly four years ago, in Washington, of the Committee on the Costs of Medical Care, a body whose task it is to study the economic aspects of the prevention and care of sickness, including the adequacy, availability and compensation of the persons and agencies concerned.

This organization was not the work of any single agency, but came from the cooperation of a number of groups and individuals concerned: physicians, sanitarians, economists, dentists, publicists, industrialists and the public. The American Dental Association, through its Board of Trustees, appointed a Committee for the Study of Dental Practice, to cooperate with the more general national committee.

The first task of such a body is to secure facts relating to its problem. Hence, various phases of this dental problem have been outlined and assigned as particular studies. Some of you are already acquainted with the first of these studies, for it was involved in the questionnaire which so many of you have already filled in. Other studies in dentistry are concerned with the cost of dental education to the student and the cost of equipment during the first year of practice; dental clinics in the United States, government insurance systems as they apply to medical and dental practice in Europe and America and what constitutes standards of dental practice.

In planning its program of work, the Committee on the Cost of Medical Care hoped to carry through its investigations within five years. The call has already been issued for a conference in 1932 which marks the end of the fourth year, at which time it is hoped that enough facts will have been obtained for the committee to begin to outline tentative conclusions. If such conclusions are to be of value to our profession, it is essential that our cooperating Committee for the Study of Dental Practice shall have progressed far along the road to completion of the studies that it has planned.

Those members of the lay public who read anything, be it books, magazines or newspapers, have been made conscious of the existence of the problem of the cost of health service, even if they have not had reason to feel the pressure of this same problem on their own pocketbooks. But this same public may not have realized that, for some time, there has been a reverse side to the problem, that dentists and physicians throughout the country

*Read before the Section on Dental Economics at the Midwinter Clinic of the Chicago Dental Society, Feb. 4, 1931.

were, in many cases, finding their incomes, through no fault of their own, far too small to meet their standard of living and to repay the investment involved in securing the education which made their services of value.

Here and there, from state to state, from city to city, little groups of dentists have met, sometimes as a discussion group having an official connection with a professional organization, sometimes merely as individuals with a common problem, to study and talk over this question of insufficient income and practice.

Unfortunately, few of those who made up such groups were fitted to discuss the question before them with any degree of authority. These are days of specialization, and, as dentists, they had received training in dentistry, but no training which might help them to meet the problem before them, the economic problem.

The business man of a generation or two ago met the business world about him in much the same way. He had little academic training for his work; he learned the fundamentals of business in the school of experience. But the modern financial world is too complicated an organism to be answered in such a helter-skelter fashion, and professional schools for business training have been organized.

The dental graduate of today is given a technical and scientific training such as no generation of men dedicated to dental health service has known before. The period of his training is longer, the scientific knowledge spread before him is more vast, because of the great increase of energy which has been devoted to research in questions of human health. But with this wealth of training, he is still not fitted for the task before him, because, in an economic world such as that existing today, any man who does not understand the controlling economic forces is handicapped. He knows nothing of business expansion or depression, nothing of management, has no well-outlined plan by which he might organize the business side of his profession. There are days in which he cannot crowd in all the calls that come for his professional services. There are other, more frequent days, when he spends long hours in his office, with only a sprinkling of appointments. He makes mistakes in estimating the costs of certain classes of work, some in his own favor, others to the advantage of his patients. Little wonder that his business affairs frequently approach a state dangerously near chaos, in which he can neither predict his income nor judge of its fairness.

Throughout the country, these discussion groups, bent on solving the money problems of the dentist, sprang from a heartfelt economic need on the part of members of the profession. They did not arise at the instigation of lecturers from business organizations. These came later and capitalized the bewilderment with which the dentists were faced.

This bewilderment is evidenced by the varying programs which many groups of dentists have adopted. Some have chosen to follow the guidance of a lecturer representing a commercial group or a supply house, eloquent, but, in many cases, little better informed than the dentists. Others have decided to adopt a scale of fees to apply to a given locality in the hope of increasing income, without adequate information on which these fees should be based. Many have embarked on extensive advertising programs, urging on the people the need of dental service, and not always in a manner to reflect credit on the profession. Of course, all campaigns urging popular attention to dental needs are not advertising. Many are genuine programs of health education. The method and material of the campaign

usually indicate whether the primary purpose is increased education to the public or increased income to the profession.

Other groups of dentists who were carrying on a serious study of the situation soon arrived at the conclusion that a great majority of the American people were not receiving dental care. The United States Bureau of Labor Statistics, they learned, had found, in a study made of the Cost of Living of Federal Employes in 1929, that, for those families receiving an annual income of $1,500 or less, the average annual expenditures of the entire family for all sorts of health services was $39.18. On the other hand, families with an annual income of $3,600 and over spent $243.98 on the average for these services. Further studies made by Michael M. Davis, to be quoted later, point to the same conclusion: that the majority of people do not receive a large enough income to purchase scientific medical and dental care.

When studies had first disclosed the fact that only about 20 per cent of the population were receiving approximately adequate dental care, the first cause considered was lack of education. These people, it was believed, did not know how important dental care was to their general health and happiness. But economic studies emphasized a more serious consideration.

Picture the dentist, Dr. Smith, member of the committee on economic research of his local dental society. He is a young man, trained in one of the best dental schools of the country; graduated, full of honors and hopes not so many years ago, and come to town to build up a practice. At times, he has been optimistic, but, of late, he is decidedly discouraged. Business conditions in the community have not been good. He has gained few new patients for weeks, and the old patients either have had their needs filled or are avoiding further appointments at present. Little wonder that he accepts his task on the committee of his society with enthusiasm, that he is anxious that something be done about the situation at once. His talent and training are lying idle, while his expenses are piling up.

Yet, on a street not so far from Dr. Smith lives William Jones, a man who is nearly as puzzled by the situation as is the dentist. William Jones has some decayed teeth; he has had a toothache off and on for several months. He knows that it is hindering him in his work, that he can't keep his mind on his job with that tooth rumbling in his head and that his decayed teeth may be responsible for other aches and pains in his body. Something ought to be done about his teeth. But what is to be done? For William Jones knows that when Mrs. Jones had a toothache recently, and it grew so bad that life was miserable for the entire family, she went to a dentist, the dentist had cared for the aching tooth and others that needed attention, and the cost of this dental service had taken two weeks of Mr. Jones' salary. He had already spent more on health service than he could afford at this time, so his own teeth must wait, especially since the school had sent home word that his children's teeth needed attention.

Mr. Jones and his wife have between them a moderate income on which to support themselves and their family. With that income, they have been able to buy the advantages of some of the inventions of the machine age: an inexpensive second-hand automobile, a radio, various mechanical contrivances around the home. These products of scientific research in cheap editions have been adapted to a scale to fit their income.

But when science has been applied to the care of the health, when it has improved on the methods of the old fashioned dentist (whose qualifications were more akin to those of the village blacksmith than of any other workman) instead of decreasing costs, increasing charges have resulted. True, science has made possible the use of anesthetics so that dental operations which were formerly painful to the point of impossibility can be performed; it has studied and, in some degree, mastered the course of dental disease which lurked in the system, and incapacitated the victims. It has added the use of the roentgen rays. It has made life safer for children and more comfortable for adults. It has produced training which has fitted men to care for the dental health of the public as never before. But such research and training are expensive.

Magazines and newspapers have combined to tell the American citizen that he deserves the best of everything. In mechanical inventions, the Jones family, with its limited income, is able to obtain at least a cheapened sample of the best; but, in dental health service, the best is too expensive for them to employ. Hence, they have joined the 80 per cent of the population which simply does not receive dental care.

Let me here point out that it is only as our advancement in scientific treatment and training are made available to human beings that they have any living value. It is only as, and to the extent that, our professional knowledge is used by the people that we have an excuse for calling ourselves an important part of the health service of the nation. Yet, at the present time, the profession of dentistry as far as service is concerned, does not exist for the major part of our population.

It is to assist both Dr. Smith and his would-be patient, William Jones, that the new research in dental economics must be directed. In some way, William Jones must be given care. In some way, Dr. Smith's talent must be utilized and his adequate income assured. The economic problem immediately ceases to be one of mere bookkeeping methods: it advances into the field of efficiency of effort and social economics.

The situation of William Jones and his family makes possible such suggestions as those recently advanced by the dean of the Dental School of Columbia University.

These suggestions are important because, in such a situation, any suggestion is important. It may be valuable, yet be ignored. It may be dangerous, and yet be adopted. The dean, in his report to the president of Columbia, suggested that, in view of the high cost of training dentists and the expense of individual offices, instead of employing our present system, we train "super-dentists," with a full medical course, followed by a dental course. Having trained these super-dentists, we should also train a large number of "artisans," technical workers, to do some of the operations in the mouth now done by the dentist—tooth drillers, tooth fillers and impression takers.

The dean then refers to a community which now has thirteen dentists serving it. He estimates the cost of educating these dentists and equipping their offices as amounting to $338,000. He then says:

> Let us take an alternative plan. To educate one doctor under present requirements with both medical and dental training would take eight years and cost approximately $25,000. Such a man could easily do the important medical and surgical work for this community. He could direct and keep busy at least twelve assistants of various types. These need only the minimum common school educa-

tion required by law. They can be technically trained in one year or less.

Desperate situations may require desperate remedies, but we doubt that the dental situation has reached this pass. Laying aside the obvious technical and educational difficulties that such a plan would involve, and its stultifying effect on the future progress of dentistry, let us simply examine its economic weaknesses. For, basically, it is advanced as an economic remedy.

Its economic argument betrays a lack of understanding of the underlying economics of the health question. It is true that the situation, a situation in which William Jones desires and needs a service and in which Dr. Smith wants to give it to him, but which neither can afford to meet, demands a remedy. Study of more efficient methods of giving that service, methods which will reduce cost on one side and waste on the other, are needed. It is possible that maintenance of the present private office with a single operator is not the most efficient method. If so, we must experiment with other plans. At present, there are no accurate data to guide us along these lines. Our study of clinics, under the Committee for the Study of Dental Practice, may throw some light on the subject.

The only real economy lies in developing efficiency, not in lowering the standard of the service given, which would be the inevitable result of cutting down the training time and lowering the grade of recruits to the profession. As a matter of fact, our machine age has developed so rapidly that we are approaching a situation in which, to quote Steinmetz, the great electrical wizard, "Within two generations it will be necessary for men to work only four hours a day to produce all the goods needed for our material wants. This shortening of the working period has already reached a point where the universality of the five-day week is only a question of a few years." Instead of training professional men, be they artists, physicians or dentists in a shorter time, we shall wish to train them more thoroughly, take advantage of those extra hours. Any movement to give quick, superficial training in such a profession is a step backwards, rather than a mark of progress.

Nevertheless, this 80 per cent of the population exists, demanding dental care, William Jones asking for the services of Dr. Smith. Michael M. Davis, in a study of "Dental Care and the Family Budget," disclosed that of twenty-six families with incomes under $900, twenty-four spent nothing on dental care; that the same was true of 197 families out of 267 earning from $900 to $1,200 a year, and that the percentage of those obtaining some dental care increased as the family income increased. A study of the families of ninety-six professors at the University of California shows that those families with lower incomes spent an inadequate amount on dental care, in spite of the fact that they belong to an intellectual class which appreciates the need of such care. Obviously, educational campaigns alone cannot solve the question. If industry is really interested in the health of its workers, it must return a larger share of its income to those workers in the form of wages, if they are to obtain the health care they need.

Many intelligent persons have pondered whether the present individual method of paying for health services is efficient or satisfactory, either to the public or to the professions. The unrest in both camps would seem to indicate that the answer is "No." Other methods which have been discussed involve: (1) deferred payment by finance companies;

(2) direct payment by the state, that is, state medicine; (3) medical service supplied by industrial units, universities and similar organizations as clinics, and (4) contributory payments, that is, insurance. In this connection, it should be stated that such contributory payments and the word "insurance" do not necessarily mean insurance companies. The principle of insurance through contributions by members of a group is older than any insurance company and is simply a method of financial cooperation to meet a future contingency.

As has been indicated by Dr. Sinai and Mr. Simons in their papers at this session, this contributory or insurance principle is the one possessing the widest vogue today; it is the one used in the greater part of the civilized world; it is the principle which is apt to determine the form in which medical and dental care in the United States will be paid for in the future. All other programs sink into obscurity before the influence of this method of meeting the problem of payment for health services.

The health professions need to study and be prepared for any change that is coming. Their attitude toward insurance has often been antagonistic because of the individualistic character of their thinking. Insurance, to them, meant collective bargaining, it meant discussion of fees rather than services, it meant lower grade service, it meant standardization. Whether these features are inherent in all forms of insurance is a question. In any case, at least a third of the health service workers in the world, outside the United States, are working under some such plan of cooperative payment for health service.

We may seem, in our discussion of the mode of payment, to have wandered far afield from the question of supplying William Jones with the services he needs. But it was the mode of payment which kept William Jones from securing these services for himself in the first place. Suppose William Jones were suddenly to learn that he could secure such care through some form of cooperative payment, some form of insurance? It would not take William Jones long to communicate this information to his friends, to his fellow-members of trade unions and other organizations; nor would it take Mrs. Jones long to secure the support of similar groups among her friends. Such groups would be quick to inform their legislative representatives of their desire that such cooperative payments be made an integral part of their own government, as they are of so many European governments today. Let many such groups express their demands, and we will find state legislatures racing with each other to install systems of insurance whereby William Jones will receive cooperative assistance to pay for his health service.

Perhaps such legislation would be good; perhaps it would be bad. In any case, if adopted, this method of payment will determine the organization of the health service, and the methods of delivery of that service. It will decide whether the individual dentist must disappear, whether he will cooperate and perhaps attain greater heights or whether he will enter into a routine factory system, with a few supervisors and a mass of machinery, like technicians.

As matters stand today, it is William Jones, the voter, and George Brown, his legislator, who will decide these questions of prime importance to the future of our profession, Dr. Smith and his fellow dentists will have little to say about these technical matters until it is too late, unless they devote time to the study now. William Jones knows nothing of the difference between good and bad health service.

All he knows is that he wants adequate care at the cheapest possible price. The member of the legislature knows no more about the matter than his constituent; all he wants is to please the voters. Unless the one technically educated group, the physicians and the dentists, do keep informed on the subject and are ready to act, they are apt to find their own future blocked and the health of the people imperiled by blind legislation.

Because of the widespread unrest in all ranks, the American Dental Association is happy to cooperate with such fact-finding bodies as the Committee on the Cost of Medical Care in an attempt to arrive at the best solution of the problem. But the American Dental Association today represents only about 50 per cent of those who are practicing dentistry. Even if the Association gives its members the information which they need to meet the situation, it will have reached only a part of the profession. Yet, in a situation such as that impending, a united front is necessary. To the lay public, membership distinctions mean little, and if the profession is not united in its understanding of conditions and in its demands, the public will go ahead and do as it pleases, regardless of the real wisdom of that course.

It is not my purpose to advise any legislative program of conduct for the future; but I do want to urge the necessity of reaching all ethical dentists outside our organization, bringing them within our ranks and working with them to study the situation before us. I believe that we would find it most advantageous to employ a carefully selected man to cooperate with the state membership committees in conducting a membership drive during the next few years. The extra income secured through these new memberships could well pay the expenses involved in securing such expert organization aid.

We are not economists: we are dentists. We cannot hope to carry on the details of the needed economic research, each man for himself, any more than we would expect economists to study dentistry in order to treat their own tooth troubles. We do need to obtain the aid of those capable of studying this situation.

There are forty-eight States in the Union. In most of them, the legislatures are meeting this year. It would be possible for bills to be introduced in a number of these legislatures tomorrow, bills which would change the entire future of our profession, bills, for instance, providing for some sort of insurance over which we would have no supervision. We should be powerless to act on them, we would not even know how we should act, because the majority of us lack information on the subject.

It is not wise for us to be left thus at the mercy of political expediency. We should have the aid of a body of experts to whom we could appeal, experts who were thoroughly familiar with every type of change in the administration of our work which might be proposed. It is to this end that I suggest that a bureau of economics be developed in the American Dental Association and hope that the report to be brought in by Dr. Brady, who has been appointed by the Trustees to draft such a project, will be favorably received. With such a national bureau, and with similar bureaus established in the various states, we would be in a position to carry on a joint work of research and education which would fit us to meet any action which might arise in any of the states.

It would be the work of that bureau to study the situation from a professional angle. It would be composed of experts in economic subjects, experts who will realize that the economics of health serv-

ice is not identical with the economics of factory production. Such a bureau would be in a position to watch the significant changes throughout the world and inform us thereon. To such experts, we could appeal when proposals were made that were beyond our knowledge. They would be in a position to give our Trustees and our membership information and advice as to the changing situations which time will bring, and prepare us to modify any proposed legislation to the mutual benefit of ourselves and the public. It would act as a clearing house for questions from the various state economic committees. The valuable suggestions of Dr. Peyser in the November *Dental Cosmos* could readily be considered by such a bureau.

It could render the dentists of the future useful service in helping the state economic committees in their endeavors to convince dental schools of the value of adequate training in economics for dental students. Such training is necessary if the professional man is to give the best health service possible in the future economic world. Nevertheless, these schools must realize that such economics cannot be synonymous with many of the courses offered by present-day departments of economics conducted in connection with schools of business. The professional man's needs in this field are not those of the future factory manager or business magnate.

The need of such training for professional men is evidenced by the surprise which they now feel at the present state of affairs and their inability to supply a remedy. The majority of dentists and physicians have in the past been unaware of the social and economic changes which were taking place about them, until suddenly they have found these changes have occurred. It is essential that they be prepared to meet the changes of the future.

Such a bureau would find no shortage of specific tasks. A study is needed of those methods of office practice which are most efficient in the cause of service, and dentists need to be kept up-to-date in such developments. There should be research in the various experiments in delivering dental service which are now taking place in clinics and similar groups, with the view of determining their economic worth and professional value. To assist young men who are looking to dentistry as a profession, more should be learned of those conditions under which it is wise to start practice in any given neighborhood, and of possible means to save the novice from that starvation period which characterizes the first years of practice. To further the development of our work to its highest possibilities, a study is needed of the standards of dental service, with a survey to determine whether they are being applied. Dental educators are, at the present time, endeavoring to determine whether the public is satisfied with the service that the dentist is giving today, and such a bureau could be of great assistance in directing such a survey.

Another problem has arisen through the suggestion of dental laboratories and supply houses that wish to conduct advertising campaigns with a view to increasing their business and, of course, that of the dentist. These organizations have money to spend for this purpose, while the dental profession lacks the scientific means of developing an official policy to meet the implications involved in such a course. If a bureau of sound scientific standing and ability were in existence, it might assist very definitely in the solution of the question.

Once such a bureau had proved its worth, scientific and professional ability and integrity, the tendency would be for it to become an integrating body to which

those lay health agencies which are now considering dental care problems would be willing to contribute funds in return for its cooperation and advice. General dental health questions could be handled more capably because of its existence, and it would act as a body which could cooperate with similar agencies in the American Medical Association, or similar groups. Without it, we will be forced to work under a handicap, for turn where we will in the field of service, of education or of supply and demand, we possess no scientific knowledge on which to act.

When America entered the recent London Naval Conference, she availed herself of the services of a large group of experts familiar with every phase of the subject under discussion and able to provide our representatives with the needed facts and materials. The American Dental Association hopes that it may approach any proposed changes in dental practice in a conference spirit with the members of the public concerned. In order to do so with any degree of wisdom, it needs the assistance of such a bureau of economics as has been suggested, composed of expert economists who are possessed of the professional point of view of the dentist and could supply our organization with the necessary facts and advice.

One of the most significant developments of recent years is found in the growth of clinics of all kinds, both medical and dental. Such clinics have increased from a very few in 1900 to more than 6,000 today, with dental clinics rising rapidly in recent years. This fact is very significant to us, furnishing as it does a point of contact with the problems of the public. It indicates that all plans for dental clinics should receive careful professional scrutiny, and in all cases where the clinic is honestly launched as an experiment in service or efficiency or both, it should receive the fullest cooperation from organized dentistry. The time has come when dentists should themselves experiment widely in the field of dental clinics. A very careful record should be kept of cost and service so that appraisals may be made as to the value and efficiency of clinics as compared with private practice.

Let us not forget that we will need many experiments before we succeed in developing successful organizations for rendering adequate dental service to that vast mass of 80 per cent who do not receive it now. And it may be that, after all our experiments are made, the private office practice of dentistry may prove to be as efficient as any.

The discontent manifested by lay groups with the health situation is natural. We must expect William Jones to be worried because he cannot pay for proper care of his teeth, for it is William Jones who suffers in comfort and health for this neglect. It is but natural that he should resent the situation, and it would not be strange if he voted to take matters in his own hands, not understanding that thereby he might injure his own cause.

To prevent this condition in the United States, European leaders in medical and dental organizations who have been through the fight strongly advise American professional men to meet the situation before it arises in this country. They urge that we lead in providing service, that we become the experimenters and that suggestions for change or improvement come from us. In that way, it may be possible to avoid any break with public opinion. The spirit will rather be one of cooperation, with the profession as experts in all phases of social change involving medical or dental service.

Now is the time for us to question ourselves: Have we so acted in the past

that William Jones and his friends will come to us for help? Have we displayed a vision which inspires him and his legislature to believe that we are anxious to cooperate in the undertaking of solving his health problems, or are voter and lawmaker alike already hopelessly estranged? I do not believe that it is too late. I think much can be done to display our desire to assist in solving the problem through making every effort to meet with lay groups to discuss the situation, to experiment and study for the future and to adopt an attitude which proves that guidance and cooperative assistance may be found with us.

Such an attitude was the keynote of the recent proposals of the British Medical Association for a complete health service, made to the British public. The association introduced its suggestions with the statement that they might "be compared to a plan submitted by an architect to a householder who wants to extend the house in which he lives, and to introduce all modern improvements. The householder may, on seeing the plan, decide that it would cost too much and that he must put up with the house as it is; or he may make suggestions for the modification of the plan. But the householder knows that if he wants to extend his house, he is, as regards essentials, in the hands of the architects and builders." The avenues of approach to lay demands are kept open but the expert advice is there at hand when needed.

To many dentists as yet untroubled by the lack of patients, which has depressed their confrères, or by the number of prospective patients who cannot afford their services, this discussion of impending changes may seem visionary and unimportant. But medical and dental men in other countries have also felt that the situation was distant and unrelated to them, only to awake and discover that laws had been passed changing their entire lives, careers, hopes and aspirations.

In discussing "Seven Years of National Health Insurance in England," Alfred Cox, in the *Journal of the American Medical Association,* reports to us from across the sea:

> A fundamental complaint always made by the British Medical Association . . . is that Mr. Lloyd George, then Chancellor of the Exchequer and in charge of the bill, did not consult the representatives of the medical profession. . . . It is impossible to exaggerate the importance of carrying public sympathy in such a fight. . . . We lost much of it when people began to think that we were irreconcilable and unconstitutional. . . . If there should be any likelihood in any of your states of the establishment of a state system of health insurance, I would urge our American colleagues to insist on being consulted *before the scheme gets to the stage of crystallization into a bill.*

Similar warnings come from other parts of the globe — France, Germany, South Africa. Across the border, in Canada, W. Harvey Smith, in his presidential address to the Canadian and British medical associations in Winnipeg in 1930, stressed the point that "the ground swell of dissatisfaction is felt . . . in British Columbia for example, where the medical profession frankly admits that state medicine is impending and so plans for dealing with the situation when it arises on a basis that will be satisfactory both to the patient and to the public."

In urging the necessity for intelligent unity in meeting the situation, *La Semaine Dentaire* addresses the French dentists with a warning of interest to us as well:

> It is certain that the stage of individualism in medicine and dentistry is ended, at least for a large part of the population of this country (France). Henceforth for this section, we must plan for collective care . . . divisions in the health forces will not fail to be

exploited against the practitioners and there is no need to emphasize the disastrous consequences that will follow.

Glenn Frank, of the University of Wisconsin, senses this new spirit of the times when he says, referring to what he calls the "Medical Revolution":

What are the implications of this medical revolution for the average man in the practice of medicine? . . . unless adequate medical statesmanship is brought in the direction of the medical revolution by men now in the profession . . . it may happen that a high powered medical machine under the sponsorship of the industries, insurance companies and governments will enter the field.

As a scientific body of men, we have met the pathologic conditions that we seek to alleviate in a spirit of analysis and experiment, and our researches have indicated from time to time the necessity of change in treatment or procedure based on the result of analysis and experiment. Must we not meet the problem of the community obligation of our profession in the same manner and spirit as we do the problems of treatment?

We must not look on change or experiment in the method of giving dental service as evil. Rather let us sift such proposals, judging their worth. No change is of lasting value to the public that contemplates, or is likely to result in, a lower standard of service. Equally injurious is any change which forces the dentist to become a trade unionist in attitude, with his mind fixed on economic considerations rather than on the patient's needs, when determining the treatment. Dental income and standing must be sufficient to insure a constant supply of high-grade, intelligent young men and women to our dental schools, for the welfare of both public and profession.

The problem before us is not one which can be solved through the leadership of a few; it is one which must be studied and prepared for by the rank and file, for complete understanding and unity of purpose are essential. Such understanding is attained only through a mental background which views the impending changes in the light of intelligent interest and constructive criticism, rather than blind acceptance or rejection.

The subject holds particular interest for the young men of our ranks, for it is their future and the profession which they have chosen for life which is at stake. If enough of them, in every part of the country, resolve to study this part of their work as carefully as they did the technical subjects of their undergraduate days, we need not fear for a future in which an intelligent and informed profession will guide public and professional men alike to a better understanding and a wider usefulness.

PREDETERMINATION OF OCCLUSAL SURFACES OF THE TEETH INVOLVED IN DENTAL RESTORATIONS*

By EDWARD T. TINKER, D.D.S., Minneapolis, Minn.

I AM aware of the fact that I am dealing with a broad subject, one requiring deep study and careful thought in arriving at a diagnosis, and involving the most painstaking attention to detail, in the carrying of a case to a successful conclusion. Opinions differ in this diagnosis; some of us are radical and some of us conservative.

I hope that I may be classed with the conservatives. I cannot but believe that Nature should be taken into consideration and that there are many types of so-called malocclusion that we had better leave as they are.

Time does not allow a discussion of the various types of occlusion. I shall merely say, in this connection, that I am convinced that there are many patients in whom a decided overbite is the normal condition for that patient, and I believe orthodontists will agree with me when I make the statement that even in childhood these cases had better be left as they are.

In making the foregoing statement, I do not wish to be understood to say that these cases are never restored, because they do call for restoration in many cases. But when they are restored, they are brought back to a normal occlusion, as nearly as can be determined, at the present age of that particular individual. Age influence means that, for example, persons of 50 cannot, owing to the weakened resistance of the investing structures, carry the depth of cusp and consequent locking of articulation that they did in their younger years.

I do not believe that the movements of the condyle have much to do with occlusion, holding to the opinion that malocclusion is a result of influences of other natures. Chief among these influences, I shall place indifferent dentistry, habits of the individual, premature loss of teeth, lack of proper bone growth in childhood and heredity, as well as many other causes.

These various conditions force teeth into improper positions in the investing tissues, making it appear in many cases that resulting malocclusion is the result of condylar influences.

Since I have discarded the theory of condylar influence and endeavored to restore cases to as nearly normal occlusion as possible, meaning by "normal occlusion," that peculiar to the patient in question, the results have been much more gratifying. One of the most important factors in obtaining balanced occlusion is the production of proper occlusal surfaces of the teeth in question.

The use of the balanced occlusal guide plate has made it a simple matter to build the tips of the cusps to the right height in cases that conform to the 8-inch

*Read before the Section on Partial Denture Prosthesis at the Seventy-Second Annual Session of the American Dental Association, Denver, Colo., July 22, 1930.

sphere and where the overbite is reduced to practically no dimension, but it has been my experience that the inclination of the occlusal planes and the depth of the sulci are of fully as much importance to a proper occlusal balance, especially when we have a deeper overbite and a shorter curve of Spee than the 8-inch sphere will permit, and there are many of them.

giving such treatment as is necessary to place it in a healthy condition and possible to obtain before the completion of the restoration. I am guided in making this statement in regard to obtaining a state of health at this time by the fact that these cases cannot be placed in a proper state of health until the causes are removed.

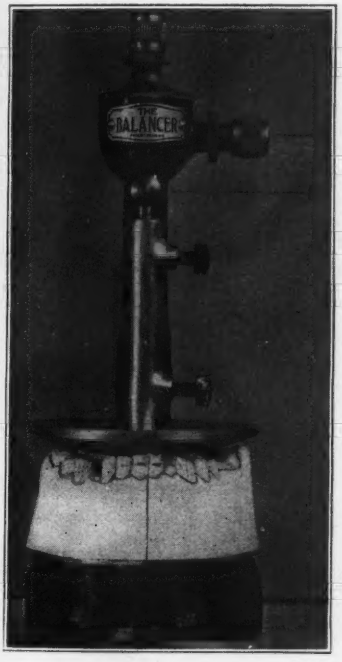

Fig. 1.—Procedure of mounting mandibular cast on instrument.

Fig. 2.—Completion of mounting.

To carve these various occlusal surfaces properly, without something tangible and definite to which to build is a difficult task. It is with this phase of the technic that this paper will deal.

The first step in operative procedure is to make a careful survey of the mouth,

In describing the following technic, I have taken for illustration the casts from a case in practice, believing that it is better to illustrate from conditions existing than from something fancied.

Figure 1 illustrates the method of mounting the casts on the instrument.

Facebow measurements are not used. A line is drawn on the cast denoting the median line of the face. The mesio-incisal angles of the cuspids are generally of the right height, so that a line drawn from one to the other will meet the median line at practically a right angle. The distal buccal cusps of the lower second or third molars, if present, will be practically the right height. The case is studied in the mouth by the placing of a balanced occlusal guide plate. If one or both slides should be low in the posterior region, some modeling compound is built into the form of a bite-block, placed in the mouth and trimmed to conform to the right height when the guide plate is placed in position.

In this particular case, a modeling compound bite-block was not necessary. The technic of mounting is as follows:

Lock the instrument in central occlusion with lock nuts *C* and *D*. Place the guide plate in position. Parallel the median line on the cast with the standard of the guide plate. A line drawn through the center of the plate, from side to side, should extend from first molar to first molar.

These precautions are taken in order that the cast of the mandible may assume

Fig. 3.—First step in diagnosis, determining extent of opening bite.

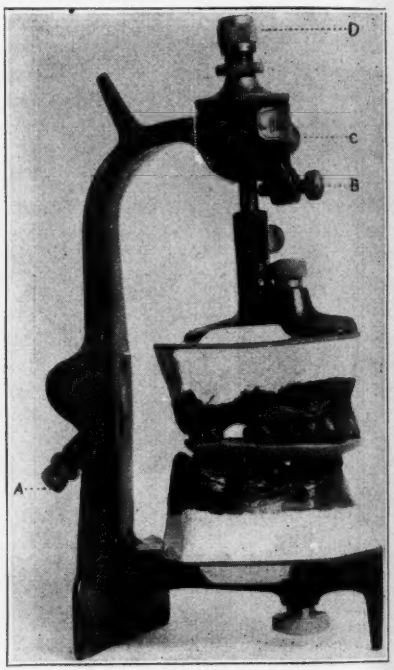

Fig. 4.—Bite-block of modeling compound taken on master cast, to be checked back in mouth, for determination of central occlusion.

its relative position on the instrument, but should it be to one side or the other, as long as it conforms to the sphere, the case will still balance, by reason of the fact that if we accept the theory of the cusps of all teeth conforming to a sphere, it does not make one particle of difference to what segment of the sphere they are working. Therefore, the facebow method was discarded.

Figure 2 illustrates the upper cast mounted to the lower in their normal relation. Attention is called to the overbite, the tumefied conditions of the gums surrounding the upper teeth in particular, the loss of certain teeth and the flattened conditions of the occlusal surfaces in the molar areas.

Figure 3 illustrates the first step in diagnosis. Set screw *A* is turned up until there is a clearance in the incisal regions in the protrusive movements. Set screw *B* is turned until the instrument is locked in that position. Set screw *B* is now released, allowing the instrument to return to full open position.

Figure 4 illustrates a bite-block of modeling compound taken on the master

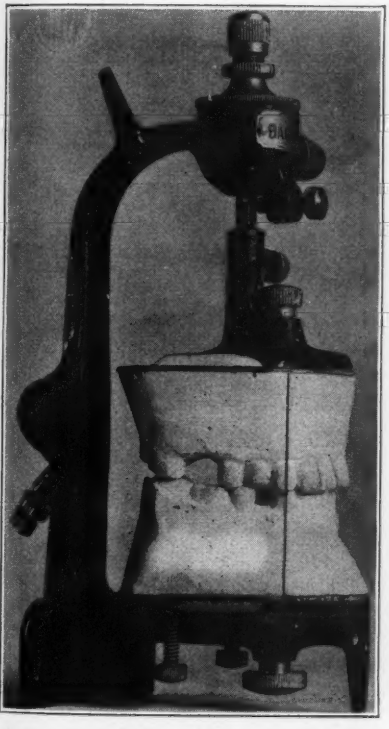

Fig. 5.—Positions studied for completion of diagnosis.

Fig. 6.—Positions studied for completion of diagnosis.

models, with the instrument opened to approximation of the position in which the upper and lower jaws will be placed when the case is completed, the compound extending well down on the lingual and buccal surfaces of the lower posterior teeth, and trimmed on the upper until merely the indentations of the cusps are visible. An adhesive powder is now dusted under the lower part of the block, and placed in position in the mouth. The patient is now required to give the various movements of the mandible until they have ground themselves to central occlusion. This is attained by causing the patient to protrude and retrude the mandible several times, following with both lateral movements. The distal points shown in the bite-block by the markings of the opposing cusps is the determining factor. The bite-block is now transferred to the lower master cast, which is already mounted on the instrument, and the upper master cast is removed from its mounting, the instrument set back to central occlusion and the cast mounted to the new relation. It is necessary at the start of each case to make two sets of casts. The first, or master, cast is poured of spence metal; then impressions are

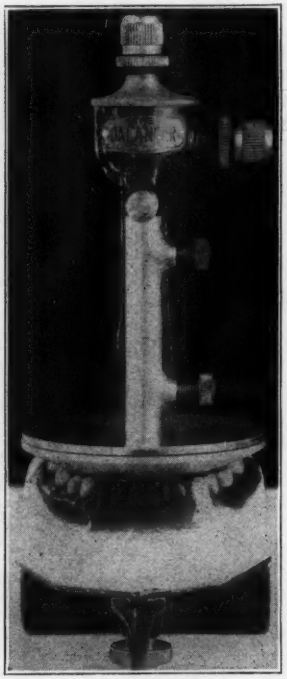

Fig. 7.—Set up of lower posterior porcelain teeth to balanced occlusal guide plate.

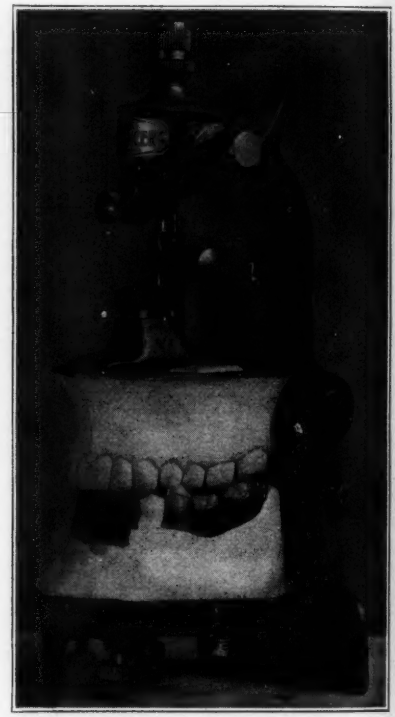

Fig. 8.—Upper master cast in position to determine buccal lingual alinement of porcelain set up; left side.

made from these casts, and working models made from them. The working casts are poured in both spence metal and plaster, usually the six anterior teeth in metal, and the rest of the cast in plaster, for reasons that will be shown later.

The working casts are now mounted on the instrument by means of the bite-block, and in order that they may be in the same position as the master cast, they are mounted alternately, the working lower cast to the upper master and then the upper working cast to the lower. The reason for making the working casts from impressions of the master casts is that it is almost an impossibility to make a bite-block that will fit casts made from different impressions of the same mouth, and in this work the bite-blocks must transfer accurately from one cast to another.

Figures 5 and 6 are now studied and the diagnosis is completed. The method of construction is definitely decided.

In Figures 5 and 6, the difference in the position of the two casts, as shown by the line of bisecting the upper and lower cuspid teeth, may be noted, Figure 5 being the closed position and Figure 6 showing the new position in central occlusion given by the bite-block and to which we build the case. It is from this point on that the technic has been

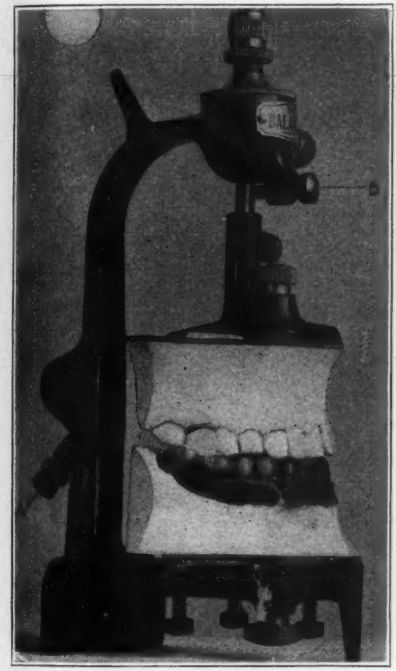

Fig. 9.—Cast shown in Figure 8; right side.

Fig. 10.—Completion of posterior porcelain set up, left side, central occlusion.

changed. The supply houses furnish us with diatoric teeth, sets of eights of various dimensions, and it is possible to find teeth among those sets that tally very closely with the measurements of the natural teeth. On the working casts, we now cut away each plaster tooth involved, and, by the aid of hard wax, place the porcelain teeth in position until we have completed the set-up on the lower cast. In order that we may place the molars and bicuspids so that the cusps are of proper height, we place the guide plate in position by removing the upper cast from the instrument, as shown in Figure 7. In this particular case, they were set to a 3 inch radius, the bicuspids being depressed in order to accommodate the overbite of the incisors. This procedure is determined in the diagnosis.

The balanced occlusal guide plate is now removed and the upper master cast placed in position. The buccal relationship between the upper teeth and lower porcelain set-up is now checked, and if the alinement is not correct, the porcelain set-up is adjusted until it is.

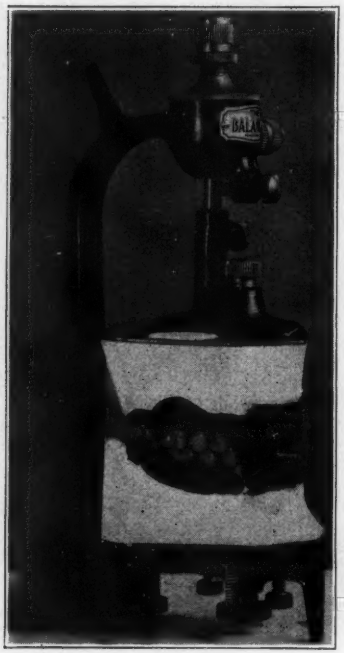

Fig. 11.—Porcelain set up in central occlusion, right side.

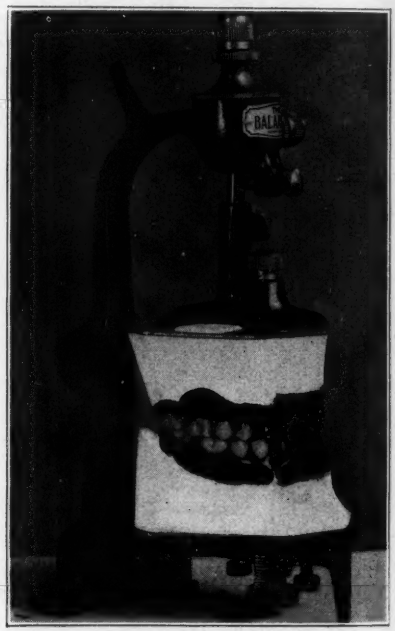

Fig. 12.—Protrusive position in balance.

In Figures 8 and 9, you will note that the second molar on the right side is in its correct position but both bicuspids are short. On the left side, all teeth, including the cuspid on the upper, are also short. We now proceed to cut these plaster teeth from the cast, setting in, as in Figures 10 and 11, the upper molars and

bicuspids. All set screws on the instrument, as denoted in Figures 12 and 13, are loosened, allowing the free movement from central occlusion to both lateral and protrusive. With the aid of carbon paper and carborundum stones, a balanced occlusion is produced by careful spot grinding, completed by the use of carborundum paste. This being a detail to which the most careful attention must be given, because if the steps have been accurate up to this point and a balanced occlusion is now produced, the finished case will function the same when cemented to place in the mouth.

This statement I make with no reservations. We are now at the point of operative procedure. The upper set-up is placed opposite the lower master cast. (Fig. 14.) We determine from this whether full crowns, three-quarter crowns or mesioclusodistal inlays are necessary, and prepare all lower teeth accordingly. When all lower preparations are made, an impression is taken in a flat bottom partial tray, modeling compound being used as an impression medium. Care must be exercised to prevent distortion in the taking of this impression. Such care is exercised by allowing the compound to remain in the mouth until it reaches the moldable state, then re-

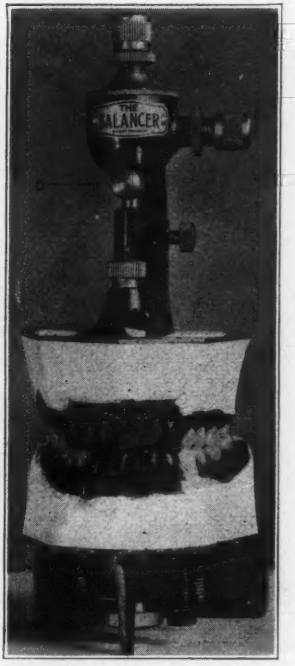

Fig. 13.—Lateral position in balance.

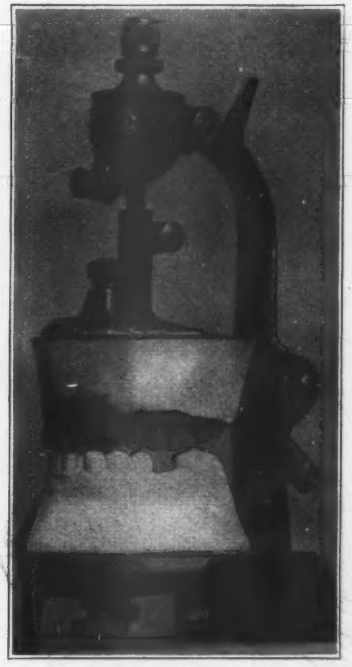

Fig. 14.—Mandibular master cast in position opposite upper porcelain set up, on the basis of which decision as to operative procedure on all lower teeth involved is made.

leasing to about one-half the length of the teeth, and replacing three or four times, breaking all undercuts. It is now removed and placed for a moment under cold water. This chills the entire outer surface, but the center will still be unset. The impression is now replaced in the mouth and firmly seated. The unchilled core will allow any distortions to correct

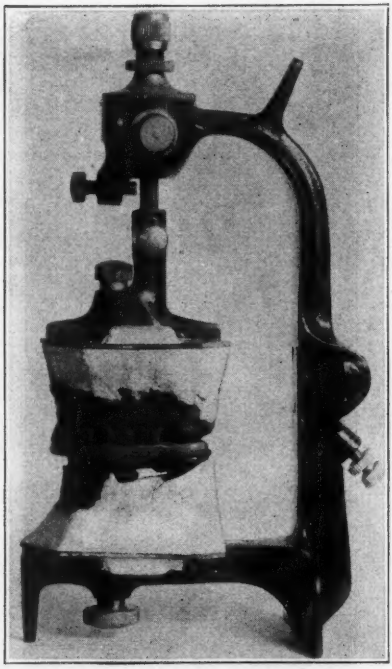

Fig. 15.—Bite-block determining correct relation between upper and lower jaws following completion of lower preparations.

themselves when forced home. The impression can now be removed with the certainty that it is correct. Impressions in modeling compound are taken of all the various preparations and copper amalgum models, made with square tapering roots. These various models are now firmly seated in the full impression and a cast of the lower jaw made of spence metal for the anterior teeth, the remainder of plaster. A bite-block made from the two original master casts is now supplemented by adding softened compound of sufficient amount to engage the prepared teeth, and placed in the mouth, and a relationship taken, as shown in Figure 15.

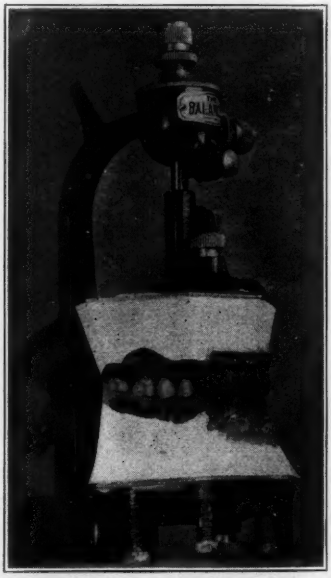

Fig. 16.—Casts in central occlusion ready for the carving of lower restorations.

The upper working cast (Fig. 16), carrying the porcelain set-up, is now placed on the instrument opposite the lower cast, carrying the models of the prepared teeth. We now construct the various crowns and bridges to this upper set-up, as though it were a simple case of crowns and bridgework. With the aid of the instrument movement, and the

upper porcelain set-up, it is an easy matter to complete the lower case, embodying the proper contours and occlusal forms, as shown in Figure 16. The main point at this stage of the technic is to retain the proper height of both sides of the lower restoration. In order to accomplish this, it is imperative that the bands carrying the softened wax be placed over the last molar amalgam model on both sides, and the instrument closed on both at the same time, and the wax crowns carved, cast and fitted.

By the establishing of the height of the crowns on both right and left against the upper porcelain set-up, the balance of the restoration is determined.

Figure 17 is taken from a plaster impression of the completed lower case, in position in the mouth, and mounted on a cast, which is then, in turn, placed on the instrument in occlusion with the upper porcelain set-up, at the time of the preparation of the various abutment teeth. Temporary cast shells are made on the amalgam models, finished to the gingival margins and placed upon the teeth, at all times during the patient's absence from the office, cement powder and eugenol being used as a temporary cement.

The teeth in question, under such treatment, remain entirely comfortable, and the investing tissue excellent. For this

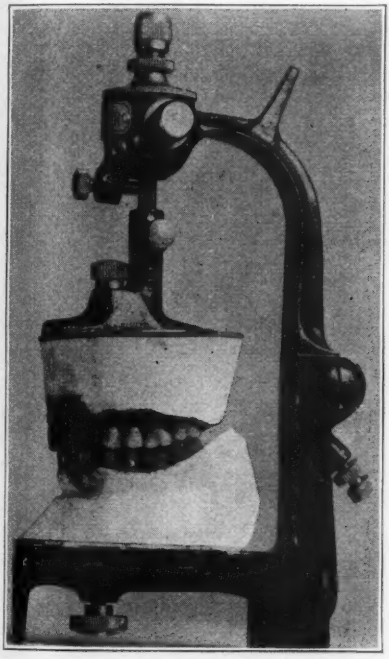

Fig. 17.—Completed lower case mounted opposite upper porcelain set up.

Fig. 18.—Completed lower case mounted opposite upper master cast to determine operative procedure on upper left side.

idea I am indebted to the Drs. Mortonson of Milwaukee.

We are now ready to construct the upper units of the restoration, the technic for which is essentially the same as for the lower. The cast carrying the completed lower restoration is mounted opposite the upper master cast, from which a study is made of the various teeth in question. (Figs. 18 and 19.)

upper left, all four posterior teeth were short in about the same degree. All molars in this case required full crowns, in order to bring the buccal surface to proper contour. The left second bicuspid was restored with a three-quarter crown; the second bicuspid on the right called for a full crown. Both first bicuspids were of sufficient fullness in their buccal contours to permit their restoration with

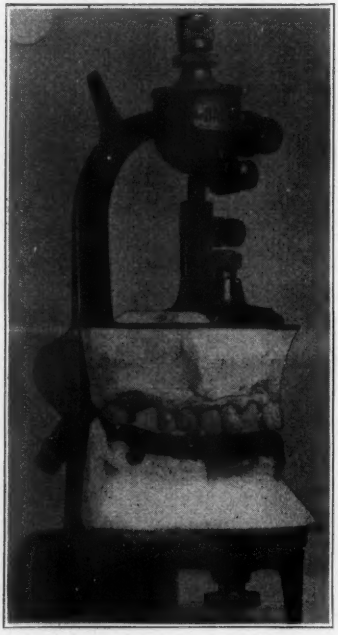

Fig. 19.—Case shown in Figure 18, for upper right side.

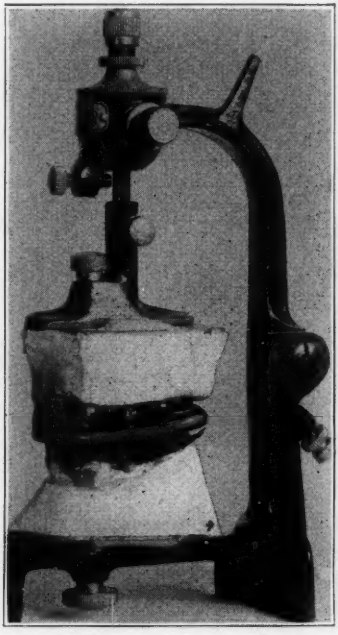

Fig. 20.—Central relationship bite between prepared upper teeth and completed lower.

You will note the difference between the right and the left side of this case. On the right side, the upper molar was a trifle too long and required shortening in the preparation. The first and second right bicuspids were a trifle short, but the cuspid was of proper length, a situation which nearly always follows. On the

mesioclusodistal inlays. After the preparation of the teeth, a bite-block, which is made of modeling compound on these casts, is used to attain the proper relation between the completed lower restoration and the upper cast, carrying the amalgam models of the preparations to which I have just referred. This relationship is

attained by placing the lower crowns and bridges in their respective positions in the mouth, and adding softened compound to the upper surface of the bite-block in the molar and bicuspid regions, in sufficient amount to engage the prepared abutments. It is now placed in position and the patient instructed to close, as shown in Figure 20.

a plaster impression, transferred to a cast, which is mounted on the instrument opposite the completed lower restoration. By means of spot grinding and the use of grinding paste, the occlusion is now balanced, after which it is cemented to position. Should the case call for anterior interference, in the way of inlays, crowns or bridges, as did this one, they are now

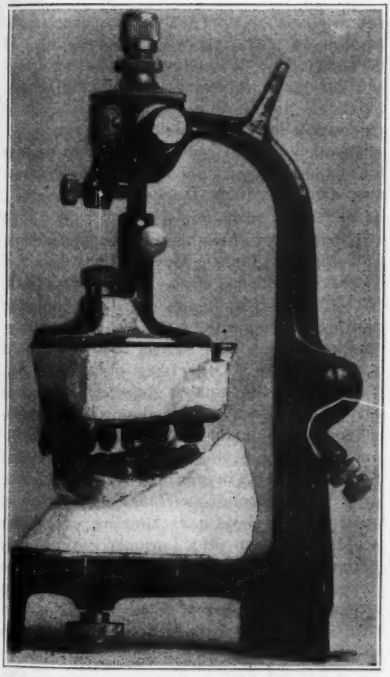

Fig. 21.—Models of prepared upper teeth mounted in cast, in central occlusion ready for the carving of restorations.

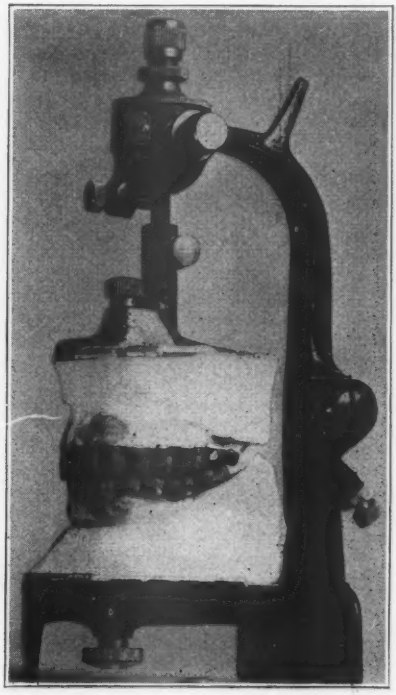

Fig. 22.—Finished case in left lateral occlusion.

Figure 21 illustrates the upper cast, carrying the amalgam models of the various upper preparations mounted opposite the completed lower restoration. The various crowns, inlays and bridges are now completed, placed in their respective positions in the mouth and, by means of taken care of, any such anterior construction always being left until we have completed the posterior units.

Figures 22 and 23 illustrate casts of the completed case in the lateral movements of the mandible. The protrusive movement is also in balance. When at-

tention to detail is given, little, if any, subsequent corrections of occlusal surfaces will be necessary, after the dismissal of the patient.

Different types of cases require different treatments, necessitating the variation of the technic to suit the case in hand.

The principle of establishing the occlusion before operative procedure is far better than spending hours in attempting to

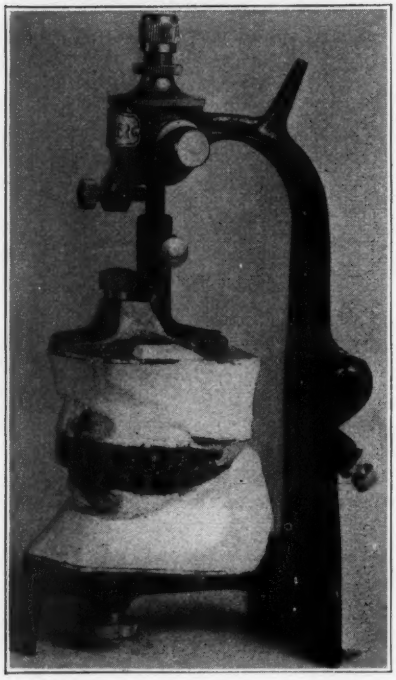

Fig. 23.—Finished case in right lateral occlusion.

attain these results by grinding after the restorations are cemented to place in the mouth.

DISCUSSION

Dayton Dunbar Campbell, Kansas City, Mo.: Occlusion is the basis of all dental practice. The simple removal of a bit of salivary calculus from the lingual border of a lower central incisor is a measure to prevent an encroachment on the investing membrane of a tooth, preserve its integrity and alinement and maintain occlusion. This is true in like measure from the humble amalgam filling to the most extensive and elaborate restoration planned for a few remaining teeth. I believe that we can all subscribe to my opening premise, first brought to my attention years ago by Dr. Waugh, but the moment that we begin to modify this word "occlusion," with terms "normal," "mal," "balanced," etc., we open the field to a great divergence of opinion. Dr. Tinker makes the statement: "One of the most important factors in obtaining balanced occlusion . . . is the production of proper occlusal surfaces of the teeth in question." I ask: Is balance a factor of much import where the restoration derives its stability from remaining teeth? In a normal dentition, all other factors being constant, is balance essential for proper masticatory function? Does the word "normal" or its related terms imply balance? We have two schools of thought: for the affirmative, Drs. Monson, Tinker, Morton, Crawford and Hight; for the negative, Drs. Dewey, Hall, McMillan and Stansbery. I will be the judge and bring in a verdict against the affirmative, which discloses, of course, my prejudiced point of view. To retrace my steps: Dr. Tinker says that one of the most important factors in obtaining balanced occlusion, where the molars and bicuspids are all involved, is the producing of proper occlusal form of the teeth in question. Had Dr. Tinker said "proper occlusal surfaces of the teeth in question," we could have hung our discussion on just what constituted proper or improper surfaces, but when he insists that they be anatomic in this premise, it is the only thing in his works of art of a mechanical nature that approaches Nature's design. Why be so particular in this instance? A tooth presenting a surface area of smaller dimension and design might lessen the stress on the abutment teeth. True, it might require additional "fletcherizing," but what is time to an individual who bolts his food? Teeth are a luxury after adolescence and not essential to life nor health. Quoting from the report of the National Society of Denture Prosthetists: "Broader occlusal surfaces require greater force to be exerted upon the supporting tissues. Artificial tooth form should be comparatively small buccolingually in order to

lessen relatively the amount of closing pressure necessary to be exerted upon the food."[1] Dr. Tinker speaks of the balanced occlusal guide plate. I know from having seen one that it is a segment of a sphere and is used with excellent results in assisting the dentist to aline masticatory substitutes so that the end-results of his efforts will more nearly harmonize with the gyrations of the mandible. It is a templet, and a templet is to test the conformity of the object we are building. Dr. Tinker speaks of "occlusal planes." To my knowledge, there is but one occlusal plane and that is the one (purely theoretical or imaginary) parallel to the lines drawn from the external auditory meatus to the alae or wing of the nose. The surfaces of all the teeth are curves, and no matter how badly worn the occlusion may be, this holds true, though the radius be short or stretched out to infinity, which, in the latter instance, may appear to the eye as a plane. (House, Prime.) When Dr. Tinker says that he does not believe that the movement of the condyles have anything to do with occlusion, he is destroying a premise for the use of his templet. I held to that theory once, as did quite a number of prosthetists, but we have all receded from that belief, and permit the condyles in their travel over the emenentia articularis to influence the alinement of the occlusal surfaces of the teeth. The difference in the condylar influence of one side of the patient is sufficient to mar efficient mastication in about 15 per cent of patients, if we are going to adhere strictly to this arbitrary guide. Fortunately, the difference in the inclination from the templet either to a steep or flat plane traveled by the condyle is, only in exceptional instances, negligible, and is corrected with comparative ease by spot grinding the point of contact that is marked by the carbon paper in lateral excursion. Since two points are invariably marked, the problem presents itself as to which of the two spots, upper or lower, we grind. As a matter of convenience and without giving the matter proper study, most operators grind the lower surfaces. (F. M. Hight.) This is wrong, since to grind the buccal cusp of the lower molar, for example, destroys its masticatory efficiency on its return to centric relation of the jaw. If the restoration be provided with porcelain surfaces, the reduction of the inharmonious and nonsynchronized contacts may be accomplished with comparative ease by the patient's use of carborundum powder. Here again, the dentist is liable to give instructions to chew, when all that is needed is a light contact between the jaws moving laterally and protrusively. This sort of instruction will carry the jaw into relations extraneous to the prehensile and real functional positions, and this is well, since some of our best groomed patients are always looking for trouble. The most important single phase of this paper by Dr. Tinker is the securing of proper centric relation after he has established a new and greater interval between the jaws so that the central occlusion of the new surfaces will be harmonized and synchronized with that new relation. In Figure 3, he shows, and perhaps should have explained, that, with an incisal pathmarker and graph-plate in position on this patient, the centric relation at the start would have shown in movements of the jaw to right and left a Gysi gothic arch. When the greater interval was established, another gothic arch would be traced by the same pathmarker anteriorly from the first, showing that a new centric relation was established when the jaw was opened and, of necessity, slightly retruded; consequently, the need for reluting one of the casts. The occluding frame that he uses has features that are to him convenient. Its ability to mimic jaw movements are fancied and only approximate. Any other two dimensional articulator using a segment of a 7 or 9 inch sphere would do the work as well, provided we had the same analytic mind and dextrous hand at the throttle. The nomenclature is a bit confusing at times. We who are sticklers for this sort of thing would say master models since a model is something to be reproduced; cast, the reproduction, as, for instance, of a wax pattern. Amalgam dies imply a metal mold as in the process of die-casting. You no doubt will waive this suggestion of correct nomenclature aside with, "Well, we know what he means." So did the traveler, when, in reply to his query as to the whereabouts of a certain denizen of the Ozarks, he was informed: "I ain't never saw nothing of him."

Dr. Tinker (closing): I did not have the opportunity of looking over Dr. Campbell's discussion, although I asked him to permit me to read it in order that I might make an intelligent answer. Consequently, I shall not attempt to answer it.

1. J.A.D.A., 18:1122 (June) 1930.

REACTIONS OF THE DENTINAL FIBRIL TO EXTERNAL IRRITATION*

By THEODORE B. BEUST, D.D.S., Louisville, Ky.

WHILE engaged in the study of the lymph supply of the enamel in 1911-1912,[1] I noted the occurrence of significant reactions in the substance of the dentin. In the experiments undertaken at that time, stains were caused to pass from the pulp cavity, through the dentin, into the enamel. The procedure affected the dentin according to its state of molecular integration. In teeth that were just beginning to erupt, it was usual, after ten days of exposure to the stain, to find the dentin stained *in toto,* as shown in Figure 1.

This photograph, taken by reflected light, shows the whole dentin thoroughly impregnated with the dye, a result differing radically from the reactions observable when the tooth of a subject advanced in age is treated in like manner. Here, the dentin resists impregnation, the tissues, when observed with the naked eye, remaining white, or almost wholly so, this depending on the condition of the tooth. (Fig. 2.) To this fact I have called attention in earlier writings.[2]

Assuming that the degree of absorption exhibited by these teeth may serve as a criterion of the state of their development, we may deduce from the reactions of the two specimens used as illustrations that the first was only imperfectly, and the last completely, impregnated with matter, calcific or organic, which resisted absorption of the stain. Assuming also that it can logically be concluded that density increases with the influx of deposit, we may appropriately term the degree to which the tissues have thus become affected the degree of sclerotization.

Between the developmental stages shown, we find transitions. For instance, we find teeth in which the dentin, when stained for the given length of time, becomes only slightly tinted, a condition which indicates a state of sclerosis intermediate between the two. I wish to emphasize that sclerosis is a normal biologic process which begins at the periphery of the dentin and progresses through the tubules centripetally. It is a growth phenomenon, and the degree of the sclerosis evidently determines the increase in resistance to caries ordinarily displayed near middle life. The enamel likewise shares in this impregnation, as large numbers of its tufts and lamellae become ob-

*From the Research Laboratory of the School of Dentistry, University of Louisville.

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*Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research), at the Seventy-Second Annual Session of the American Dental Association, Denver, Colo., July 22, 1930.

1. Beust, T. B.: Arch. f. Zahnheilk. Nos. 1-2, 1912; Dent. Cosmos, 54:659 (June) 1912; Dent. Rec., 32:660, 1913.

2. Beust, T. B.: Dent. Summary, 44:474 (June) 1924.

literated with this stain and acid resisting matter.

Viewed with the naked eye and by reflected light, sclerosed areas appear darker, more definitely gray or yellow, than the unaffected dentin. This applies more especially to those sclerosed areas

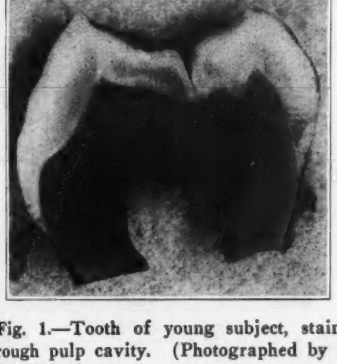

Fig. 1.—Tooth of young subject, stained through pulp cavity. (Photographed by reflected light.)

Fig. 2.—Diagonal section of a senile tooth. The plane of the section severs the tubules. (Stained both before and after sectioning.) Only a slight penetration of tubule bundles lying in close proximity to the pulp has occurred. (Photographed by reflected light.)

which are composed largely of transparent dentin. Figures 3 and 5 show teeth ground to expose the pulp cavity. The peripheral portion of the dentin displays shaded areas, more or less isolated from one another. Immersion of such a tooth in tincture of iodin for a few hours, followed by a vigorous rubbing with a cloth moistened with water, reverses the conditions. (Figs. 4 and 6.) Because of the presence of open tubules, the unsclerosed white portions have, through the absorption of the iodin, become darkened; while the sclerosed portion, resisting the impregnation, now appears relatively lighter.

Fig. 3.—Worn cuspid showing sclerosed (darker) markings under the morsal surface and under a labial cavity. (Photo by reflected light.)

The phenomena described indicate the occurrence of active metabolic changes in these tissues. The question as to whether these depositions occur through the agency of a free and unobstructed flow of lymph or through what is known as diffusion has no practical bearing on the result. It is equally certain that the

changes are effected through pulpal activity, which justifies their inclusion under metabolism.

Living tissues react to external influences. External stimuli are regarded in biology as irritations. Under irritations, then, we understand any stimulation which elicits a response. Response, in the case of dentin, consists of a hastening of the otherwise normally occurring sclerosis. Sclerosis, owing to the diverse irritations acting on the dentin, rarely proceeds uniformly. At times it appears, apparently erratically, in isolated regions of the tooth. Its occurrence and progress is partly governed by the age, diet and resistance of the individual, the environment of the tooth, localized irritations and, partly, the rate of contraction of the pulp cavity resulting from dentin deposit.

Fig. 4.—Tooth shown in Figure 3, treated with iodin. The sclerosed dentin under morsal surface and decay appears white. (Photographed by reflected light.)

Abrasion, occurring as denudation caused by mastication or by proximal wear and loss of the investing tissues caused by pyorrhea, is an irritation caused directly by environment. Morsal abrasion is generally followed by hastened sclerosis of both the coronal portion of the tooth and the pulp itself (Figs. 7 and

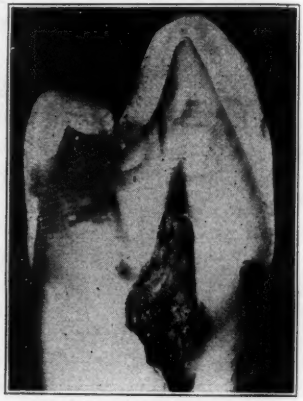

Fig. 5.—Immune tooth with sclerosed dentin (darker) under the morsal surface. (Photographed by reflected light.)

Fig. 6.—Tooth shown in Figure 5 after treatment with iodin. (Photographed by reflected light.)

8); while proximal wear, or even interdental pressure without visible wear, may cause a sclerosis under the area affected. (Fig. 9.) In many cases, the dentin is found to be sclerosed, probably through stimuli extending along the lamellae or tufts, before the enamel is worn through.

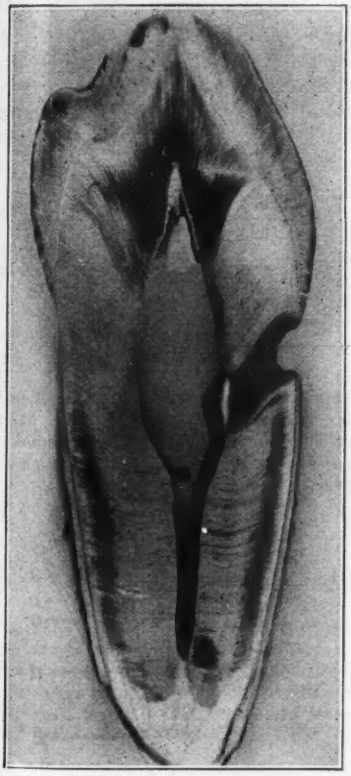

Fig. 7.—Tooth with transparent dentin in apex of pulp cavity and under gingival decay. (Photographed by transmitted light; specimen ground by D. E. Caush.)

Recession of the gum and alveolar process through pyorrhea results in general tubular sclerosis of the whole part of the tooth thus abnormally exposed, which may account for the immunity to caries ordinarily exhibited by these teeth. (Fig. 10.)

Reduction of the size of the pulp cavity through a normal or secondary dentin deposit is in itself a factor in the transformation of countless fibrils into sclerosed tissue. The reduction causes functional elimination of the mother cells.

Fig. 8.—Section shown in Figure 7, placed on a black background and photographed by reflected light. The color of the markings is now reversed. The transparent dentin is now invisible. The dentin seen under the cavity in Figure 7 is here shown to be sclerosed. The shadows seen in the dentin over the pulp cavity are here seen to have been caused by sclerosed dentin.

This elimination process continues until, in extreme cases, all of the fibrils and the pulp itself become transformed by depositions. Theoretically, this would be the fate of any tooth, provided the span of life sufficed for the transformation. Such sclerosed fibrils have attained their maximum state of development and constitute a functional part of the organism.

Figure 11 visualizes diagrammatically the effects of contraction of the pulp cavity through normal growth. *c* indicates the position of the odontoblastic layer at an early stage of dentin development. Here, we find a large pulp cavity lined

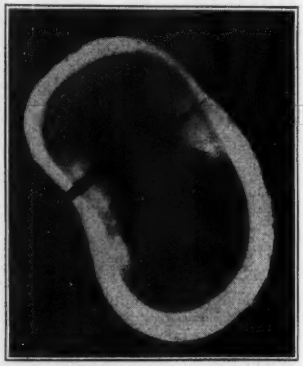

Fig. 9.—Sclerosed chromophobic dentin lining the proximal walls. The section is stained. (Photographed by reflected light.)

with an extensive *membrana eboris*. *e* shows the conditions in an older subject, the number of odontoblastic fibrils having necessarily, through dimensional decrease of the pulpal wall, likewise decreased. It may be estimated that only from one fourth to one third of the fibrils found in the dentin at *b* will be in open communication with the pulp when dentin deposition has reached the point *e*, shown in the diagram.

That this diagram corresponds with the conditions observable in nature may be seen by examining the distribution of the tubules in Figure 12. This can be done where stained or sclerosed tubules permit their distribution to be followed. It will

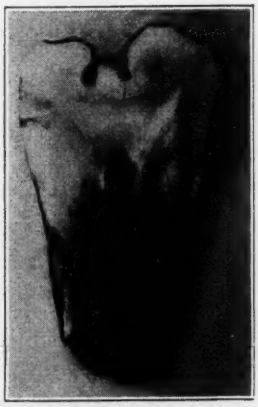

Fig. 10.—Pyorrheic tooth, stained both before and after sectioning. The stain has entered the tubules lying in close proximity to radicular portion of pulp. (Photographed by reflected light.)

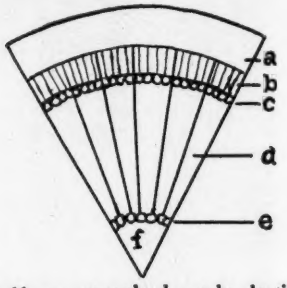

Fig. 11.—*a*, enamel; *b*, early dentin; *c*, early odontoblastic layer; *d*, late dentin; *e*, late odontoblastic layer; *f*, pulp cavity.

be seen that they form a cone, with the apex toward the pulp.

Figure 13 is an exact tracing of the central and peripheral ends of the stained

tubules shown in the upper half of Figure 12. Sclerosis of fibrils with subsequent loss of their odontoblasts is therefore a physiologic phenomenon incurred by the contraction of the pulp cavity. Sclerosis of the fibril evidently precedes elimination of the mother cell. This can be inferred from the almost complete absence of open tubules in the dentin of senile teeth. The changes here described, through which myriads of tubules lose direct communication with the pulp, should contribute to diminishment of sensation and to increased caries resistance.

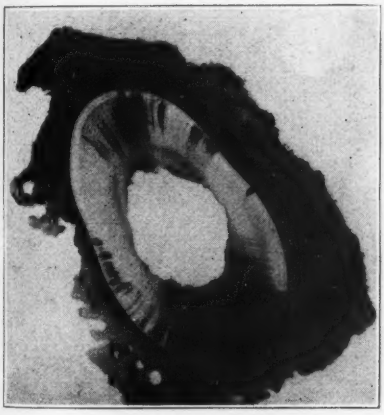

Fig. 12.—Root of a cuspid of dog, stained in the jaw. The darkened tubules in the upper part of the figure are stained. The shadows in the lower part of the figure are caused by sclerosed dentin. (Photographed by transmitted light; compare with Figure 9.)

It may be held that the number of odontoblasts in a very young tooth are crowded into a number of layers by the contraction of the pulp cavity. Such a view is not tenable. In my experience, the appearance of several layers seems to result only where the section passes through irregularities in the lumen of the canal. It cannot be disputed, even if this point is disregarded, that odontoblasts are only relatively sparsely represented in highly contracted pulps. It may be added that sclerosis of the fibrils appears to precede the senile atrophy of the pulp.

It must not be overlooked that not all of the tubules found at the dentin periphery are closed during the life of a highly contracted pulp. The peripheral portion of the dentin and even many of the tufts and lamellae retain their connection with the pulp until the odontoblasts supplying fibrils to this region undergo functional metamorphosis. The late supply is usually had through bundles of open tubules.

We can now understand why uniform impregnation of all of the tufts, lamellae

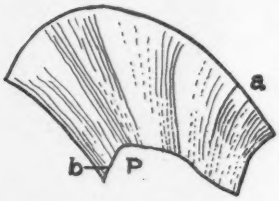

Fig. 13.—Diagram showing the length of early odontoblastic layer (*a*) and the present odontoblastic layer (*b*). *P*, Pulp cavity.

and dentinal fibrils cannot occur when the teeth of adults are subjected to staining experiments.

The presence of an irritant acting on parts of a tooth over a considerable period of time results, as has been implied, in a sclerosed area. The existence of such areas under caries, fillings and abrasions has long been known. They have been commented on by Leber and Rottenstein, Kolliker, Magitot, Tomes, W. D. Miller, Percy R. Howe, G. V. Black and other investigators. The interpretation placed on the phenomenon of translucency varies, one school regarding it as a filling

of the tubules by a calcific deposit, another as a zone of decalcification, with resultant swelling of the tubule walls, while a third regards the cause as a fatty degeneration of the fibril.

Staining experiments convincingly demonstrate that two forms of translucent zones occur, a variety generally referred to in this contribution as sclerosed, and a second variety, immediately adjoining the focus of advancing caries, consisting of tissue undergoing decalcification. The first of these two forms we may, for convenience, characterize as chromophobic, the last as chromphilic.

These two forms have been confused by some investigators. The translucent zone found to occur under stationary or slowly advancing caries and properly inserted fillings is of the first variety, being a sclerosed area in which the tubules have become obliterated. This area may appear anywhere in the dentin between carious areas and the pulp, in advance of the chromophilic variety, where it resists the onslaught of the attack. (Figs. 14-16.)

Translucency is not necessarily a concomitant of sclerosis. We have a form in which the tubules, though visible microscopically, are impervious to dye. The same phenomenon can be observed in the tooth root, where the spaces in the granular layer, although visible, have become impervious to stain. These forms of sclerosis occur side by side. Sclerosis without transparency causes dentin to become

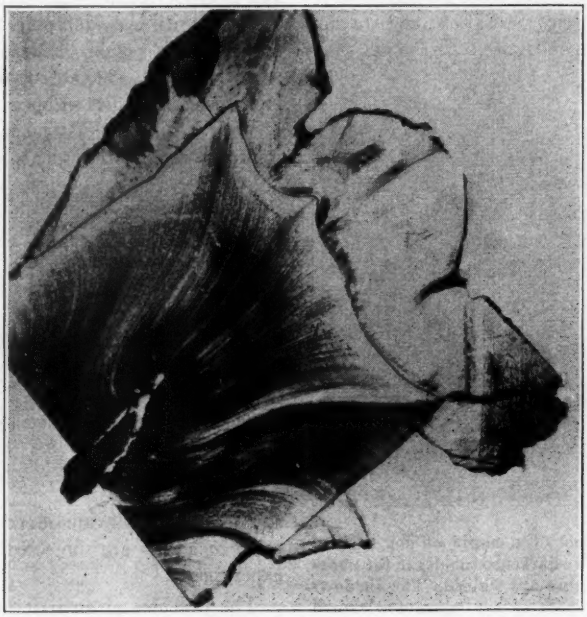

Fig. 14.—Decayed tooth stained both before and after sectioning. (Photographed by transmitted light; see Figure 15.)

more opaque than is normal. This is probably the form referred to by W. D. Miller as the opaque stripes or zones bordering the translucent zones of caries.

It is important to note that the occurrence of this form is not necessarily the result of any lesion but that it permeates the dentin of subjects past middle life. denser and more impervious than normal dentin.)

By reflected light, the opaque variety appears white (Fig. 8), closely resembling normal dentin. In thin sections over a black background, transparent zones become invisible, and the opaque variety become more prominent. In sclerosis,

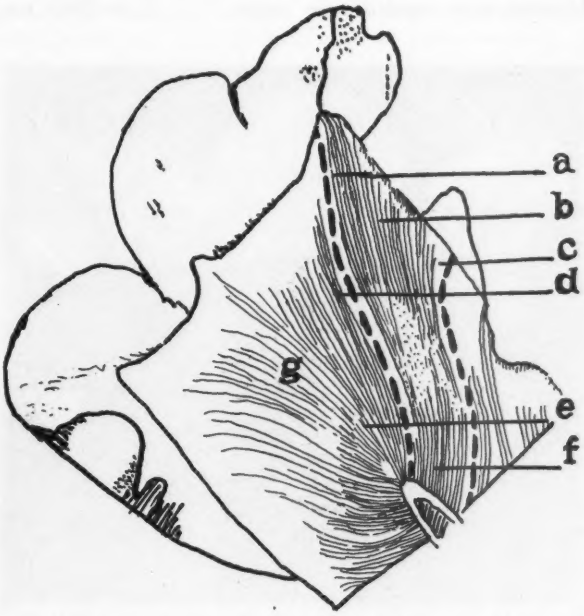

Fig. 15.—*a* and *c*, transparent dentin, marked by the broken lines, which confine the dentin affected by the caries. *b*, dentin stained by decay, containing isolated, dilated stained tubules. (Compare Figure 14.) Between *d* and *e* lies a zone of chromophobic tissue composed of a mixture of transparent and opaque sclerosed dentin; *f*, zone of normal, stained tubules, which open to the pulp; *g*, shadows cast by sclerosed tubules. (Compare Figure 1.)

Observed by transmitted light, it casts a shadow and cannot be differentiated from stained dentin, or from dentin that has become darkened by decay. (Figs. 17 and 18; compare also Figs. 7 and 8 and 3 and 5.) (Those who think that even small cavities can infect the pulp should take note of this reaction, for this dentin is opacity is more common and possesses the same significance as transparency. It is not altogether improbable that the opacity may be transformed into transparency.

What has been said about depositions within the tubule is obviously in accord with any interpretation which may be placed on the deliberations of the larger

school of older writers who believed in calcification of the fibril, and consequently should need no further comment. Recently, contentions were published by E. W. Fish[3] which cannot be brought into harmony with the earlier views on biologic phenomena occurring in the dentin. Fish's research, owing to its intimate relation to today's theme, necessarily demands careful consideration, more especially as it presents the latest that has been published on the problems involved.

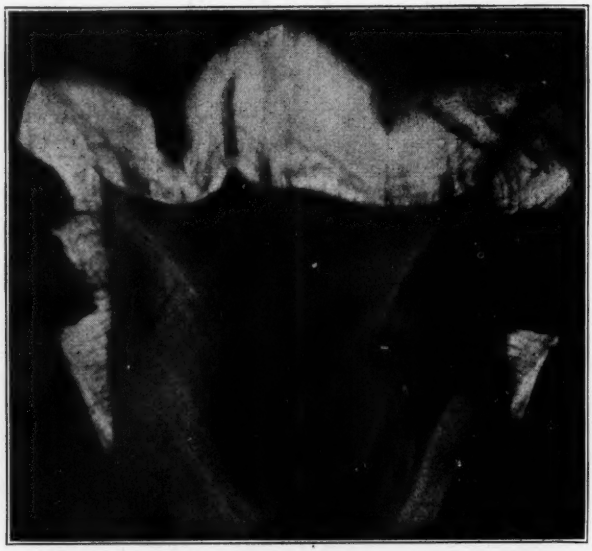

Fig. 16.—Section shown in Figure 14 placed on a black background and photographed by reflected light. The transparent zone is invisible. Sclerosed opaque dentin underlies and borders the transparent zone.

Fish's assumptions are based largely on the extent of penetration occurring in tissue when exposed to the influence of dye-stuffs. In adopting this means of demonstration, Fish has entered a research field well smoothed by the experience gained in countless staining experiments.[4] His utilization *in vivo* of a technic in which stains were caused to permeate from the pulp cavity through the tubules into the enamel was a welcome procedure. In his own words, Fish confirms my early inferences, ". . . if the tissue was permeable in life, it was similarly permeable after death" (p. 597).[5] He also states that the only difference between the intravital and the postmortem experiment is that, "in the one case the dye is carried by diffusion,

3. Fish, E. W.: Physiology of Dentin, Brit. Dent., J. 49:593 (June 1) 1928; Lesions of Dentin and Significance in Production of Dental Caries, J.A.D.A., 17:992 (June) 1930.

4. Caush, D. E.: Proc. of Fourth Internat. Cong. 1:170, 1904. Footnotes 1 and 2. Mummery, J. H.: Brit. Dent. J., 43:607 (July) 1922.

5. Footnote 3, first reference.

in the other by the lymph circulation (p. 1001).[6]

It is with much satisfaction that I call attention to this substantiation, as evidence of existing connections between the pulp and the enamel, based on the staining experiments, has not been accepted in some quarters. The procedure utilized by Fish corresponds so accurately with the conceptions, methods and results of both my 1912 investigation[1] and the 1922 investigation of Mummery that I infer that these publications were overlooked by Dr. Fish.

Fish assumes that resistance to caries is to be sought, not in the substance of the dentin itself (within the tubule), but only in the pulp. I do not accept this view. He objects, in his opening paragraph (p. 992[6]) to the view that the translucent zone under caries is an indication that the dentin under the floor of the cavity is alive and reacting, and holds that such a zone is by no means always present. In fact, he adds, "more often than not it is absent." Again, on page 1007,[6] he writes, ". . . the translucent zone itself is very uncommon . . ."

Fig. 17.—Worn tooth photographed by transmitted light. Transparent and sclerosed opaque dentin are found under the apex of the crown.

Fig. 18.—Tooth shown in Figure 17, photographed by reflected light.

It is not the present purpose to determine the frequency of occurrence of translucent zones but to defend the general statement that the formation of sclerosed dentin under areas of decay is not an exception but is the rule. This statement disposes of the view expressed by Dr. Fish that a dentinal fibril which is open and comes in contact with the mouth fluids, or with a foreign body, dies and the death of the whole tract of dentin from the site of the injury through to the pulp results (p. 993[6]). Dr. Fish seeks to establish the fact that caries is to be regarded as a putrefactive process in a dentin filled with necrotic fibrils. He also regards the effects of other irritations in the same light. He writes ". . . there is no difference in the underlying dentin, whether the lesion be attrition, irritation of the exposed dentin at the neck of the tooth or early caries. In every case we see an infarct, a dead area of dentin right down to the pulp" (p. 600[5]).

Fish bases his ideas on the circulatory phenomena occurring in the dentin. He

6. Footnote, 3, second reference.

makes a differentiation between circulation and diffusion. As this distinction has often been made and has a bearing on what is to follow, it appears appropriate to devote a few words to its discussion. Fish writes, "If one wishes to postulate a true circulation of fluid along a space in contradistinction to diffusion, it is necessary to cause solid particles to be transported from elsewhere into this space . . ." (p. 594[5]).

In the present state of our knowledge as to what takes place in the dentin or enamel, the term circulation, when applied to the hard tissues of the teeth, should signify any movement of fluids, regardless of whether diffusion, osmosis, dialysis or free and unobstructed flow is meant. The passage of solid particles is obviously governed by the magnitude of the lumen of the spaces being considered and by our abilities of discernment. Particles of a given size may pass through tubes or filter pores of a given size but may be held back by finer ones, only the vehicle being allowed to pass, and the attending physical phenomena being in the two cases identical. Pure noncorpuscular lymph, in order to sustain the vitality of the chondroblasts, "circulates" through the matrix of hyalin cartilage. We recognize an intracytoplasmic circulation.

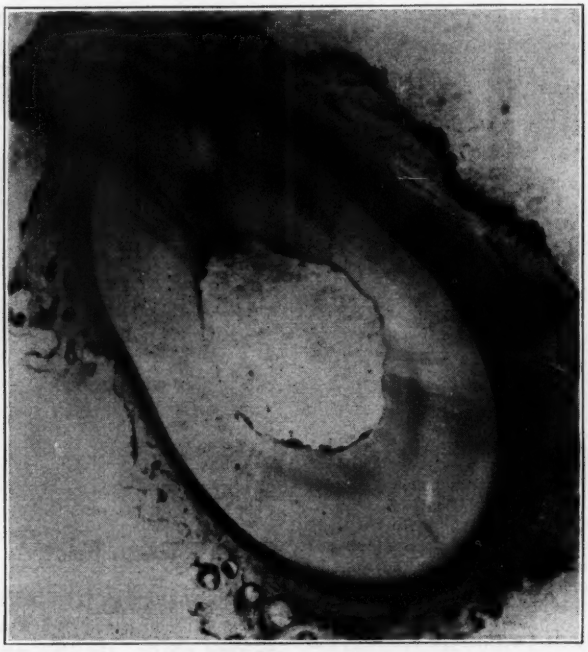

Fig. 19.—Tooth shown in Figure 12 photographed by reflected light. The dentin in the lower part of the figure which appeared dark by transmitted light is here shown to be sclerosed tissue.

Taken collectively, these illustrations give little justification for distinctions, more especially as Dr. Fish is seen, in his discussion, to assume a circulation in parts of the tubule (the peripheral region), in which he states that the lumen is too small to admit the solid particles of India ink. In fact, he assumes, in the context of his work, a circuitous flow in the dentin, in that he regards his "marginal lymph plexus" (p. 595, 596[5]) as the connecting link in the circuit. Closure of this circuit, according to his arguments, means death

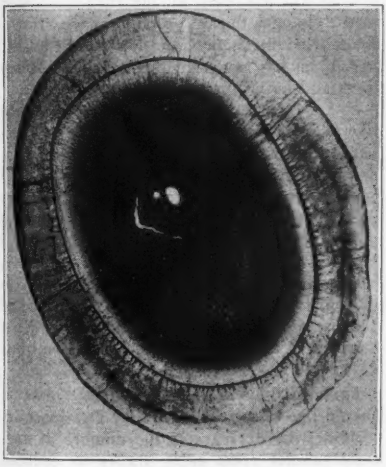

Fig. 20.—Stained section with chromophobic transparent dentin underlying the enamel. The tubules in the transparent region have almost entirely disappeared.

of the fibril. He writes, "It would appear inevitable that any peripheral injury must interfere with the movements of this lymph . . . this means degeneration of the fibril and ultimate death of the whole tract of dentin from the site of injury through to the pulp" (p. 993[6]). He also states that there are grave theoretical difficulties involved in supposing that a dentinal tubule can be open at one end and alive at the other; that this would imply "that the lymph in the central end of the tubule is alive and reacting although the tubule is blocked and the lymph unable to circulate" (p. 992[6]).[7]

I am of the opinion that the so-called plexus can add nothing to our knowledge of the mysteries of the lymph movement, for it is a matter of common observation that destruction of this plexus through the introduction of foreign bodies, such as fillings, which must of necessity obstruct the flow, is not followed by the death of the fibril, but by a physiologic deposition of matter within the tubule. An interruption of such a flow must likewise result from the normal sclerosis of the dentin periphery (Fig. 20).

The following conclusions appear justified:

1. An irritant acting on a fibril commonly causes a reaction within the tubule, leading to its complete obliteration. Caries of the dentin therefore cannot be regarded as a simple proteolysis of dead tissue.

2. A progressive sclerosis of the soft parts of the dentin, due to the normal contraction of the pulp cavity, is a factor in the resistance of a tooth to caries.

DISCUSSION

Percy R. Howe, Boston, Mass.: The matter of circulation in teeth is of extreme moment to us, especially in view of the research of modern times. Anybody who has been in practice for a long time and has worked in the laboratory must be convinced of this fact. I quite recently heard an investigator say that he was not able to stain teeth. I cannot understand that. I have injected dogs with vital red interperitoneally and within a few hours found the dentin of the tooth, and, I be-

7. Bödecker, C. F.: Soft Fiber of Tomes, a Tubular Structure: Its Relation to Dental Caries and Desensitization of Dentin, J. N. D. A., 9:281 (April) 1922.

lieve, the enamel, penetrated throughout. Those of you who have been in practice for many years are perfectly familiar with the fact that if arsenic is placed in contact with dentin the pulp will eventually die. As this must be carried to the pulp by dentinal circulation, an afferent and efferent circulation must exist. The process by which the formation of secondary dentin occurs is of extreme moment to us since this is a real preventive of decay. Healed caries Miller called it. The blocking of tubules with calcium deposits is familiar to almost anyone who has ground and stained teeth. The difficulty of staining the teeth with blocked tubules,the gradual disappearance of the pulp and the eventual calcification of the pulp, are indications that the teeth change. Certainly, the teeth are unique if a certain amount of the circulation does not reach them, for every other tissue in the body is reached in some way. Therefore the circulation is of extreme moment to us, for it means that wherever there is circulation, general systemic effects are felt. As regards active calcification, nobody knows much. There is no subject that has been more often studied than that of general calcification, and none that has been more often dropped. What the active agents concerned in it are we do not know. But we are learning and in the laboratory can induce the odontoblasts to build or to destroy dentin, to form dentin or bone and we can study the process step by step. The enamel, of course, is a heavily mineralized mineral substance. If we understand anything about the formation of the translucent area in dentin, then in enamel a pulp relation must exist. I have many teeth in which the enamel in certain areas is impregnated with lead. These were obtained from workers in the chemical works at Niagara Falls. How did the lead get there except through the circulation? The actual act of poisoning does not begin to occur until the bone gives up its lead. The important thing to me in the whole matter is the fact that we are beginning as professional men to regard the teeth as a part of the human body and not as mere dermal appendages of the human body. I have come to believe that dental decay and pyorrhea, and other irregularities of the teeth, are not of so much moment on account of their distinct conditions as they are as indications of general systemic disturbances. The pediatrician is dealing with crises; he is dealing with acute conditions that demand immediate remedy of some sort, but he passes by a patient who has a mouthful of decayed teeth. He is wrong. A mouthful of decayed teeth is just as much an indication of metabolic disturbance as the coated tongue is of stomach trouble. I have no hesitation in saying that. I say it from my experience in working on a great many animals. It is such studies as those of Dr. Beust which are making for the advancement of dentistry as a science.

Edward H. Hatton, Chicago, Ill.: I have one question: "Did Dr. Beust use fat soluble stains in bringing out the facts that he has given us?" I am convinced from my own careful study of the work of Fish that he did not use fat soluble stains in the study of what he called dead areas in dentin; and if he did not, he did not learn all the facts concerned in the changes that have taken place. If Dr. Beust used them, my question is irrelevant; and if he has not used them, he should use them and he will get other information.

F. S. Meyer, Minneapolis, Minn.: I should like to ask two questions: Does not this secondary dentin that is formed become more brittle than the original dentin? When the cusp breaks off sometimes after the tooth has been filled, is that not caused by the cusp having become a great deal more brittle? What is the cause of the darkening of, we will say, a lateral incisor when it is backed by a three-quarter crown? A lateral incisor will darken a great deal more than a cuspid will. What happens to the circulation to bring about this darkness?

Samuel W. Chase, Cleveland, Ohio: I should like to inquire as to how Dr. Beust determines the decrease in the number of dentinal tubules from early stages in dentinal formation to late stages. I may have missed his explanation by coming in a little late, but I should like to know something about his method. Regarding the circulation in the dentin and enamel: I have been doing considerable work along that line in repeating and extending the experiments of other investigators, and have come to somewhat different conclusions from those of Fish. As I am to report on this work, I do not need to go into my findings at this time other than to say that, under proper conditions, it is just as easy to cause India ink to enter the dentinal tubules in the dead tooth as in the living tooth. Hence it seems to me that Fish's work in that respect is not conclusive proof of circulation. I think we are using the term "cir-

culation" very loosely in all our descriptions of this work. We all realize that all the tissues of the body must have moisture to remain in the living state, and certainly the dentinal tissue must have tissue fluid present in order to retain a living condition. All of the work of Fish can be explained on the bases of capillary attraction and diffusion, and it seems to me that we are making a mountain out of a mole hill when we try to introduce the term "circulation" into the subject. I do not believe there is circulation in the true sense of the word. There is penetration of the dentin, and, under certain conditions, penetration of the enamel, by fluid. But all that can be accomplished by simple diffusion in the living stages and by capillarity in the experiment in which India ink is used.

G. K. Dice, Tipton, Iowa: Do you believe there are secretory tubules in the enamel?

Henry Klein, Baltimore, Md.: The circulation, diffusion, penetration or entrance of fluid into the enamel or dentin is not quite so simple a physical phenomenon as one might at first be led to believe. In recently published studies on the enamel of dogs and pigs[8] it has been shown that the enamel displays properties of quite a complex order. I should like to call attention specifically to the fact that any diffusion process through either the enamel or the dentin must be intimately related to complex physicochemical phenomena.

8. Klein, Henry, and Amberson, W. R.: J. Dent. Res., 9:667 (Oct.) 1929. Klein, Henry: J. Dent. Res., 10:447 (Aug.) 1930.

Dr. Beust (closing): I feel grateful to Dr. Howe for substantiating the views here expressed. As regards Dr. Hatton's question, I must confess that I used only the anilin dyes, the methylene blue and the alcoholic basic fuchsin. I do not know what bearing the use of the fat soluble stains will have on this question. Dr. Hopkinson asked about the relative permeability of the teeth of the human being and the dog. I cannot say that I find any difference. I have experimented with both. The important point is to have young teeth which are not yet perfectly calcified throughout. To Dr. Meyer's question concerning the brittleness of tooth structure after the calcification of the tubule: I can only say that these teeth are harder to grind and are less liable to split in the making of sections than are the teeth of young subjects. So I infer that they must be stronger in every way. Why a lateral incisor appears dark as a result of a backing is to be explained in the translucency of tooth substance, which is very evident when dark fillings are placed in thin-walled cavities. That is the only explanation that I can give. I was glad to hear Dr. Chase agree with me that tissue lymph is contained in the dentin. The only point that we disagree on is the word "circulation." I am willing to call it diffusion or anything else. I have made no experiments with India ink. I know of no secretory tubules in the enamel. I have always contended that enamel contains tubules, that is, in the sense that we have continuous spaces, filled, of course, with a protoplasmic substance. Whether one should call these tubules is a question of nomenclature.

BROKEN NEEDLES

By SANFORD M. MOOSE, D.D.S., San Francisco, Calif.

SUGGESTED procedure for the removal of broken hypodermic needles is occasionally found in the literature; either in the nature of case reports, or to emphasize some special technic. The use of stereoscopic roentgenograms, pilot needles, magnets and the fluoroscope has been given a worthy place in the literature. These contributions are invaluable, but only facilitate one of the most tedious operations confronting oral surgeons, operations presenting so many

unpleasant ramifications that a serious condition is resulting.

To be confronted with one of the most troublesome and unpleasant sequelae of our practice is ample reason to give this question more than casual consideration.

Unfortunately, owing to present laws which enable the plaintiff to file suit without a bond, most of the broken needle cases are terminated either in a court of law, or, through intimidation, the dentist assumes responsibility and thereby admits guilt for an accident which in no way indicated his carelessness, lack of ordinary skill or criminal negligence.

The usual guilty attitude is sufficient evidence for conviction. Each conviction or cash settlement in a patient's behalf is a selling point in favor of such legal actions and is usually passed along to the next person who has an opportunity to use it.

The ever-increasing number of legal actions against our fellow practitioners can be the result of only one factor, e. g., education of the public as to the ease with which cash recovery can be accomplished for alleged damages. Too frequently does the dentist offer to pay the specialist to whom he has referred his patient; feeling that in so doing he is pacifying the patient and that the money is well spent.

If a needle breaks, the patient should be informed in a matter-of-fact manner and advised to consult a specialist for its removal. Let us maintain our poise and not act as if we had committed a crime. Unless a general practitioner has had an exceptional amount of experience along these lines, it is not wise, I believe, to attempt recovery.

The unsatisfactory state of affairs leads to many attempts to dissemble and to misadvise patients. Suggestions to leave needles in the tissue, with the assurance that their presence is inconsequential or not serious, are ill-advised.

We must stop here and analyze the two aspects of what constitute serious sequelae. I have observed several cases of nervous breakdown, and many bordering on this condition, in patients who have allowed the presence of an unrecovered needle to prey on the mind and cause mental suffering beyond comprehension. It is therefore my opinion that an attempt should be made to recover all lost needles, unless their anatomic location is such that the patient's life or future comfort is jeopardized by attempts at removal.

The case herein described is one in which removal was declared inadvisable and retention inconsequential. The needle was lying in the vicinity of the mandibular foramen and, from the clinical history, was impinging on the inferior dental nerve, causing considerable discomfort. Aside from these direct or local symptoms, the patient manifested an extreme and continuous mental disquietude, which was reflected by her mother and other members of the family.

By way of illustration of mental attitudes, allow me to quote the words of the mother, who, with tears in her eyes, told me after the operation: "Doctor, you took that needle out of my heart." This particular needle caused sharp paroxysms of pain, very frequently followed by "gnawing" neuralgia, radiating throughout the entire side of the face and the neck. There was no reason that the removal of a needle so situated should be discouraged.

The principal difficulty in this case was due to the extreme external lateral divergence of the ascending ramus from the longitudinal plane of the body of the mandible. Its internal surface was ex-

tremely concave, with a prominently developed ledge, overhanging lingually, beneath which was an unerupted third molar. The molar fold was at least 2 cm. internally toward the internal oblique line of the ramus, which made the field quite inaccessible.

The primary facilitating factor in operating in such cases is liberal incision, allowing ample access and retraction of both lips of the wound, with a minimum of tension. The incision was made immediately over the internal oblique line, from a point behind the distoclusal angle of the superior alveolar process, and carried down through the buccinator and temporalis muscles to the gingivolingual angle of the second molar and forward to the first molar. All muscle attachments and mucoperiosteum were elevated from the mandible buccally and lingually to the first molar. With the field so prepared, one is enabled to open the wound and have ample access to the underlying tissues. At this point, care must be taken to include the lingual nerve within the lingually retracted mass of tissue. The search and dissection should be thorough and systematic, combing each area through which we pass with a small well-tempered steel probe. Good thumb forceps and hemostats should be within easy reach of the operator, as often a needle is located or sighted and disappears again if there is unnecessary delay.

A most important suggestion in this technic is the use of a fixed or mechanical mouth gag. It is absolutely essential that this be employed, whether we are operating under a local or a under a general anesthetic. This procedure is often overlooked in operating under a local anesthetic. If it is omitted, the patient may, at a crucial moment, just as the needle comes within the grasp of the forceps, close his mouth or change the angle of distention and the needle is again lost to sight.

In cases of extreme concavity of the internal surface of the ramus and lateral divergence, it is necessary to work from the opposite side of the mouth; hence, it is necessary to place the gag on the side of the operation instead of the opposite side, which is the usual procedure.

As broken needles are the basis of a large proportion of malpractice damage suits, a remedy for this most common source of trouble should be welcomed by all practioners using local anesthetics.

It is acknowledged that a needle usually fractures at the point at which it enters, or is attached to the hub and also at the guard if one is used. Consequently, one remedy for the loss or breaking of needles is obvious. Do not use short needles. It is not necessary to have various length needles for different intraoral injections, provided the one selected is long enough. A 42 mm. needle seems to be a standard and safe length. Should a fracture occur, with an injection technic approximately correct, there will usually be a sufficient portion of the needle protruding from the tissues to be easily grasped and removed.

This is not a theory, but is borne out by experience in a clinic, where the technicians are inexperienced students, and where, since the introduction of long needles, losses have been reduced from a common occurrence to a rarity.

There is no reason for using a short needle except for pressure, and as pressure on needles is to be discouraged and injections made superperiosteally with only sufficient pressure to expel the solution, it appears that the foregoing modification of one's technic will be reasonable assurance against this dreaded accident.

In conclusion, I might suggest the inadvisability of operating for the recovery of needles in a septic field, where the tissues have been traumatized by previous attempts at recovery or extraction, and where there is any suppurative process. These conditions should be treated and the tissues allowed to return to their normal tone before operation.

450 Sutter Street.

CHANGES IN COMPOSITION OF AMALGAM ALLOYS DURING AMALGAMATION AND CONDENSATION*

By K. W. RAY, Ph.D., and GEORGE S. EASTON, D.D.S., Iowa City, Iowa

THE properties of amalgams seem to depend on several factors, some of the more important of which are: (1) the method of making, comminuting and annealing the alloy; (2) the method of mixing, kneading and packing the amalgam; (3) its composition, and (4) its age and integrity. The effects of each of these factors on the properties of amalgams have been carefully studied and are now fairly well known.[1] In studying the effects of the composition, little attention has been paid to any of the changes that might occur in the composition of the alloy during the process of amalgamation and condensation.

In preparing amalgam for, and during the process of, insertion into the cavity, the dentist usually produces three distinct alloys, each of which has a different mercury content. The first is produced when the excess mercury is expressed from the mass of amalgam, and consists largely of mercury. The second is made up of the soft, semifluid material that is brought to the surface during condensation and then removed from the cavity. The third consists of the packed amalgam, that is, the finished filling. This packed amalgam is said to consist of a compound of silver and mercury (Ag_3Hg_4) and possibly a similar compound of copper and mercury, together with a solid solution of tin.[2] The more nearly complete the elimination of the free tin, the stronger and more stable the filling is said to be.[3]

It is well known that the excess mercury which is expressed during amalgamation and condensation carries out some of the metal content of the alloy; but it appears that little work has been done to determine the amounts of the various constituents so removed.

Two general methods of amalgamation are in use. In the one, an excess of mercury is used, the alloy and mercury are mixed and kneaded and the excess is then removed before or during condensation.

*From the Metallurgy Division, Department of Chemistry, and the College of Dentistry, State University of Iowa.

1. Black, G. V.: Dent. Cosmos, 38:982 (Dec.) 1896; Gray, A. W.: Tr. Am. Inst. Min. and Met. Eng., 60:693, 1919. Souder, Wilmer, and Peters, C. G.: Tech. Paper of Bureau of Standards No. 157, 1920, and others.

2. Harper, W. H.: Significance to Dentists of Physicochemical Changes Incidental to Amalgamation and the Hardening of Dental Amalgams, J. A. D. A., 12:34 (Jan.) 1925.

3. Harper, W. H.: Amalgam: Its Working Peculiarities and Its Operating Demands, J.A.D.A., 13:1122 (Aug.) 1926.

In the other, a minimum of mercury is used so that only a little can be expressed during condensation. It has been stated[4] that by using an excess of mercury, a better mix is obtained, and that a harder and stronger amalgam can be secured, provided the excess mercury is removed before or during condensation. It is also held that this method gives a packed amalgam of a different composition from what would be estimated from the formula of the alloy, since the expressed mercury carries out the metals originally present in different amounts.

The solubility of each of the constituent metals separately in mercury is well known. Van Heteren[5] has found that about a 1.24 atomic percentage (equal to 0.73 percentage by weight) of tin will dissolve in mercury at 35 C. Zinc is even more soluble. According to N. A. Puschin,[6] 2.84 per cent by weight is present in a saturated solution of zinc in mercury at 36 C. Copper and silver are much less soluble. T. W. Richards and R. N. Garrod-Thomas[7] state that only 0.0024 per cent of copper is soluble in mercury, while Reenders[8] gives the solubility of silver as 0.042 per cent at about room temperature.

By applying these degrees of solubility to a practical example, their magnitude becomes clear. For example, if an amalgam is prepared using an alloy-mercury ratio of 6:9, and if the excess mercury is expressed before or during condensation, leaving the packed amalgam to consist of 50 per cent alloy and 50 per cent mercury, it is possible to calculate the composition of the packed amalgam and also to calculate the amount of the various metals carried out. Table 1 shows the results of such a calculation.

Thus, it is seen that only about 60 per cent of the amalgam is to be found in the packed portion (finished filling). This indicates that if the degrees of solubility of the metals of an amalgam alloy were the same as they are separately, the only appreciable change in composition during amalgamation and condensation would be a slight increase in the silver

TABLE 1.—COMPOSITION OF AMALGAMS AS CALCULATED FROM THE SOLUBILITY OF THE COMPONENT METALS IN MERCURY

Composition of Original Alloy		Original Metals Removed Per Cent	Original Metals in Packed Amalgam Per Cent	Composition of Material Removed	Composition of Packed Amalgam
Silver	67.0	0.03	99.97	0.08	33.58
Tin	26.0	0.13	99.87	0.32	13.00
Copper	5.0	0.07	99.93	0.17	2.50
Zinc	2.0	7.15	92.85	17.54	0.92
Mercury	0.0	33.33	66.66	81.87	50.00

4. Gray, A. W.: Tr. Am. Inst. Min. Eng., Sup. Bull. No. 144, 1918.

5. Van Heteren: Ztschr. Anorg. Chem., 42: 129, 1904.

6. Puschin, N. A.: Ztschr. Anorg. Chem., 36:214, 1903.

7. Richards, T. W., and Garrod-Thomas, R. N.: Ztschr. Phys. Chem., 72:165, 1910.

8. Reenders: Ztschr. Phys. Chem., 54:609, 1904.

content and a medium decrease in the zinc content. J. W. Mallet,[9] working with platinum-tin, platinum-silver and tin-copper alloys, found that the action of mercury on alloys is not the same as on the component metals taken separately. Therefore, there may be several factors nearly as important as solubility in the change in composition occurring during amalgamation and condensation. The rate of solution should be important. R. A. Joyner[10] found that, in some cases, the mercury had to remain in contact with the alloy for a week or more before it became saturated with the component metals. In ordinary dental procedures, the mercury is in contact with the alloy for only a few minutes before all the excess is removed. A second factor may be the state of combination of the metals in the alloy. Since amalgam alloys very seldom contain appreciable amounts of free metals, but usually consist of a mixture or solid solution of intermetallic compounds, such as Ag_3Sn, Sn_4Cu, etc., it should not be expected that the solubility of the metals would be the same as it would if they were present in the uncombined state. A third factor might be the viscosity or fluidity of the constituents of the amalgam. The mercury expressed by the dentist nearly always carries some semisolid material, and is not a true solution. The material thus carried out mechanically may or may not be different in composition from the amalgam as a whole. It is thus seen that the composition of the condensed amalgam may or may not be different from the composition as calculated from solubility alone.

It appears that little work has been done to determine the change in composition of amalgams during amalgamation and condensation. J. H. Jonte[11] investigated the relation of the composition of packed amalgams to the composition of the unpressed amalgams when varying amounts of mercury were used. From these results, he calculated the change in composition of the alloy during amalgamation and packing. He concluded that "the excess mercury, when pressed from an amalgam, removes tin and copper in greater amounts than it does silver." Since he used only nonzinc alloys, since

TABLE 2.—COMPOSITION OF DIFFERENT ALLOYS OBTAINED DURING AMALGAMATION AND CONDENSATION OF MINIMAX 178*

Metal	Alloy	Packed Amalgam	Expressed Excess Mercury	Fluid Portion Removed During Condensation
Silver	67.30	68.03	63.85	66.86
Tin	26.95	26.32	31.94	28.13
Copper	4.60	4.64	4.30	4.50
Zinc	1.08	0.87	1.42	1.24
Total	99.93	99.86	101.51	100.73
Mercury in portion (per cent)		54.0	85.0	62.5

*Results have been calculated mercury-free; alloy-mercury ratio, 6:9.

9. Mallet, J. W.: Proc. Roy. Soc., 80:83, 1908.

10. Joyner, R. A.: J. Chem. Soc., 99:195, 1911.

11. Jonte, J. H.: Thesis, State University of Iowa.

he packed the samples under very high pressure into steel molds and since his results indicate experimental errors, his work is not of great value in answering this question from the dentist's point of view.

It was the purpose of this investigation, therefore, to make a study, under conditions as nearly identical with those existing in dental practice as possible, of the changes in composition of amalgam alloys that occur during amalgamation and condensation of the amalgam formed. It was also desired to determine whether or not appreciable amounts of any of the metals are carried out by the expressed mercury, or removed with the more fluid portions as they are taken from the cavity during the process of condensation. To do this, a chemical analysis was made of (1) the alloy used, (2) the mercury expressed after amalgamation and before condensation, (3) the semifluid portion removed during the packing process and (4) the packed amalgam (finished filling). The results were then calculated to the mercury free basis and these results compared and tabulated.

EXPERIMENTAL METHODS

Crandall's nonzinc, twentieth century, true dentalloy and minimax 178 were the alloys used in this work. These were chosen as being representative of amalgam alloys in general, all of them having passed the specifications of the American Dental Association.[12] An alloy-mercury ratio is recommended by the manufacturer for all but one of the alloys. Many other alloys might have been chosen as equally representative as the ones used, but only four were considered necessary.

The alloys were amalgamated in accordance with the manufacturer's published instructions where any were furnished. The correct amounts of alloy and mercury for the ratios used were obtained by careful weighing; and trituration was accomplished with a glass pestle in a glass mortar. The trituration time was three minutes, and all of the mixing and condensing was done at a temperature of approximately 22 C.

The amalgam was condensed into a specially prepared mold similar to that

TABLE 3.—COMPOSITION OF DIFFERENT ALLOYS OBTAINED DURING AMALGAMATION AND CONDENSATION OF MINIMAX 178*

Metal	Alloy	Packed Amalgam	Expressed Excess Mercury	Semifluid Portion Removed During Condensation
Silver	67.30	68.17	44.86	67.14
Tin	26.95	27.03	49.77	27.19
Copper	4.60	4.55	1.88	4.62
Zinc	1.08	0.92	6.20	1.28
Total	99.93	100.67	102.71	100.23
Mercury in portion (per cent)		55.5	94.5	64.0

*Results calculated mercury-free; alloy-mercury ratio, 7:11.

12. Taylor, N. O.: A Specification of Dental Amalgam Alloys, J. A. D. A., 17:112 (Jan.) 1930.

described by C. S. Van Horn.[13] It consists of a brass casing containing a steel plunger ground to a sliding fit. One end of the plunger was tooled to form the pulpal, axial and gingival walls of a mesioclusodistal cavity, the surrounding walls of which were formed by the brass casing. It was held in place by means of a tapered hard steel pin extending through the casing and plunger. When the pin was removed, the end of the plunger containing the packed amalgam could be extruded from the casing and the amalgam filling subsequently removed therefrom.

The technic followed in condensing the amalgam was similar to that described by Harper.[14] No mercury was removed from the first portion of the amalgam; some was expressed from the second, and the third was freed of as much as possible. Great care was taken to prevent the loss of any of the expressed mercury, or of the soft, semifluid material that was brought to the surface during condensation. The force of condensation was estimated to be approximately from 800 to 1,100 pounds per square inch. Mallet pressure was not used.

In this way, the samples were obtained for chemical analysis. One contained all of the mercury expressed before condensation; a second contained the soft, semifluid material removed during condensation, and the third consisted of the packed amalgam. In those cases, where the mix was so dry that sufficient mercury could not be expressed for a chemical analysis, any mercury which was expressed was added to the soft material removed during condensation, and the two portions were analyzed together.

Table 4.—Composition of Different Alloys Obtained During Amalgamation and Condensation of True Dentalloy*

Metal	Alloy	Packed Amalgam	Expressed Excess Mercury	Semifluid Portion Removed During Condensation†*
Silver	66.88	66.94	This portion was too dry	66.80
Tin	26.52	26.48	to permit of the expres-	26.64
Copper	4.85	4.90	sion of sufficient mercury	4.82
Zinc	1.61	1.70	for an analysis (see text).	1.84
Total	99.8	100.02		100.10
Mercury in portion (per cent)		49.00		63.50

*Results calculated mercury-free; alloy-mercury ratio, 9:11.

†*This portion also contains the very small amount of mercury, expressed before condensation.

Gravimetric methods were used in making all of the chemical analyses. The original alloys were analyzed by the ordinary methods of dissolving in nitric acid, and determining the tin as stannic oxid (SnO_2), the silver as the chlorid in a Gooch crucible, the copper electrolytically, and the zinc precipitated as the sulphid and then ignited and weighed as the oxid. The same procedure was followed for the amalgams except where the

13. Van Horn, C. S.: Dent. Cosmos, 67:160 (Feb.) 1925.

14. Harper, W. E.: J. Dent. Res., 1:446, 1919.

mercury made changes necessary. After the solution of the sample in nitric acid, about 5 gm. of ammonium persulphate was added to oxidize all mercurous salts to the mercuric state so that they would not interfere with the silver determination. After the silver determination, the mercury was separated from the copper and zinc by precipitation as the metal by hydrazin[15] from an ammoniacal solution. The copper and zinc were then determined as before.

RESULTS

The compositions of the various portions, calculated mercury free, are given in Tables 2 to 6. The amount of mercury in each is also shown. The amount of expressed mercury was usually too small for accurate chemical analysis, there being only about 0.5 gm. containing approximately 90 per cent mercury, so that only about 0.05 gm. of alloy was present. Since microdetermination was not used, the experimental error was quite large in making the analysis of this portion. The general characteristics of this part are well shown.

The results obtained indicate that the change in composition during amalgamation and condensation is not at all serious. The tin is carried out to a greater extent than any of the other metals except zinc, but the packed amalgam never becomes deficient in tin, since the difference amounts to only a few tenths of 1 per cent. The silver content of the packed amalgam seems to be increased slightly in most cases, while the copper also seems to accumulate in this portion. The greatest difference is in the case of zinc. This metal is carried out in relatively large amounts by the expressed mercury in those cases in which the mercury-alloy ratio is high. Since the zinc does not appear to be a very necessary constituent of amalgams, especially in large amounts, the removal of a part of this metal by the expressed mercury is probably not a serious defect.

It also appears from the results that the only major difference between the semifluid material removed during condensation and the packed amalgam is the mercury content. If this soft, semifluid material were pressed free of the excess

TABLE 5.—COMPOSITION OF DIFFERENT ALLOYS OBTAINED DURING AMALGAMATION AND CONDENSATION OF TWENTIETH CENTURY*

Metal	Alloy	Packed Amalgam	Expressed Excess Mercury	Semifluid Portion Removed During Condensation
Silver	68.67	68.90	36.77	68.50
Tin	26.24	26.14	50.43	26.48
Copper	4.98	5.01	2.19	3.86
Zinc	0.24	0.12	5.28	0.48
Total	100.13	100.17	94.67	99.32
Mercury in portion (per cent)		48.50	96.00	63.00

*Results calculated mercury-free; alloy-mercury ratio, 5:9.

15. Willard, H. H., and Boldydreff, A. W.: J. Am. Chem. Soc., 52:569, 1930.

mercury, it could be used again, at least as far as composition is concerned.

CONCLUSIONS

1. The mercury expressed and the semifluid portions removed during the amalgamation and condensation of amalgam alloys causes slight changes in the composition of the packed amalgam as compared with the composition of the original alloy.

2. The zinc content is decreased to a comparatively large extent.

3. The tin content is but slightly decreased.

4. There is a slight increase in the silver and the copper content.

5. The use of excess mercury during trituration, and its subsequent removal from the amalgam, does not greatly affect the composition of the packed amalgam.

6. The excess mercury so removed does not carry out sufficient amounts of any of the component metals to destroy the balance of the amalgam.

TABLE 6.—COMPOSITION OF DIFFERENT ALLOYS OBTAINED DURING AMALGAMATION AND CONDENSATION OF CRANDALL'S ALLOY*

Metal	Alloy	Packed Amalgam	Expressed Excess Mercury	Semifluid Portion Removed During Condensation†
Silver	70.04	70.21	This portion was too dry to permit of the expression of sufficient mercury for an analysis (see text).	69.88
Tin	26.20	26.24		26.35
Copper	3.85	3.80		3.58
Zinc	0.00	0.00		0.00
Total	100.09	100.25		99.81
Mercury in portion (per cent)		49.50		62.00

*Results calculated mercury-free; alloy-mercury ratio, 10:12.

†This portion also contains the very small amount of mercury expressed before condensation.

ORAL LESIONS—THEIR DIAGNOSIS AND RELATION TO THE PHYSICIAN AND THE DENTIST

By ARTHUR E. SMITH, M.D., D.D.S., Los Angeles, Calif.

SINCE the primary cause of 90 per cent of all disease is located in the tonsils and oral cavity, a grave responsibility is placed on the dentist, requiring not only thorough training in the mechanics of dentistry, but familiarity with pathology, laboratory examinations and physical diagnosis.

During the past ten years, dentistry has made rapid advancement not only in reconstructive restorations but also in the histologic, bacteriologic and pathologic phases of disease. Heretofore, the dentist was regarded as a mechanic, an individual who made teeth, filled teeth and pulled teeth. Modern scientific achievement has taken from the dentist the rôle of dental mechanic and placed him on the honored plane that is enjoyed by the doctor of medicine. The services of a highly trained, well-qualified dentist are more vital to maintenance of good health through the prevention of disease than the services rendered by other specialists of medicine, because a large percentage of the diseases treated by medical specialists have their origin within the oral cavity.

Modern dentistry prevents such common pathologic dental sequelae as endocarditis, myocarditis, arteriosclerosis, nephritis, gastric ulcer, appendicitis, the anemias, maxillary empyema, otitis media, iritis, osteomyelitis, actinomycosis, skin diseases and frontal sinus infection; for a clean tooth never decays; vital and normal positioned teeth harbor no septic foci, and employment of the services of a highly trained dentist prevents oral disease and thus prevents the development of many local and general systemic diseases. A clean mouth, vital teeth and noninfected or eradicated tonsils are synonymous with good health.

The presence of diseased tonsils, carious teeth and pyorrhea alveolaris causes foul breath, impaired health and pathologic changes of body tissues or vital organs. The oral origin of a staggering percentage of diseases has placed dentistry on a plane equal to that of medicine. Modern discoveries as to oral manifestations of general systemic disease have resulted in the broadening of dental training. The dentist of the old school must familiarize himself with modern pathology, diagnosis and treatment. The day for the mechanical dentist is gone. Advancement and modern discoveries have indeed revolutionized diagnosis and treatment, and those not familiar with modern advancement soon find themselves greatly handicapped in practice, because the oral hygiene movement in our schools and educational articles in the press are educating the public to the fact that good health is not compatible with focal infections from the teeth and tonsils.

In the past, the duties of the dentist have been principally to remedy defects caused by dental decay and loss of teeth, giving little or no consideration to the broader pathologic conditions of the oral

tissues. His knowledge of oral pathology and of general pathologic processes and physical and bacteriologic diagnosis has been limited. This has resulted in oral disease progressing to a stage difficult or impossible to arrest, when early medicinal or surgical treatment would have arrested the condition in its primary state. Examples of such diseases are cancer, syphilis, leukoplakia and Vincent's infection.

The well-trained dentist experiences little difficulty in making correct diagnosis because he is familiar with the pathology and bacteriology of the teeth, jaws and surrounding tissues, and has a general knowledge of physical diagnosis. The operator who is an artist in the construction of an inlay, filling or dental restoration and inserts them upon infected teeth is not the highly trained dentist. Dentistry of this type was the dentistry of yesterday, practicing before the advent of the roentgenogram and before septic dental foci were recognized. Beautiful mechanical restorations lose their value, and the reputation of the dentist is lowered when periapical infection is disclosed by the roentgenogram or the teeth have abscessed. The patient was impressed with the dentist's ability because the restorations were beautiful, were comfortable and answered the purpose of mastication; but the necessary removal of these infected teeth later because of systemic involvement lowers the standard of dentistry and injures the reputation of the dentist. Dental infection may persist for years, causing no noticeable effect, until progressive toxic absorption leads the patient to seek medical aid.

Every practitioner of dentistry should know enough about diagnosis to be able to determine whether an oral lesion is within his realm of practice, and if it is not, and he is a conscientious practitioner, he will refer the patient to a well-trained specialist for surgical and medical treatment.

The dentist should be familiar in a general way with cleft palate and cleft lip operations, impactions, the surgical removal of infected teeth, surgery for empyema of the antrum, treatment of Vincent's infection, removal of dental cysts, etc. He should not insert an obturator for cleft palate when a plastic operation is indicated. He should not open an infected antrum through the mouth when nasal drainage accomplished by simple puncture of the naso-antral wall is indicated. He should not treat a patient for pyorrhea and overlook Vincent's infection. He should be able to differentiate a syphilitic chancre and epithelioma of the lip. He should differentiate tic douloureux from symptomatic neuralgia. To possess a general knowledge of the many oral diseases and lesions does not mean that he must be expert in surgery or medical treatment. If the patient has a cleft palate or cleft lip, he should be aware of the benefits to be obtained by an early plastic operation. To make a diagnosis of a syphilitic chancre or mucous patch does not mean that he should be expert in the administration of neo-arsphenamin and mercury, but to be able to diagnose such conditions, and to refer the patient to the genito-urinary specialist is part of his professional duty. The conscientious general practitioner of dentistry does not treat oral conditions or operate beyond his realm, because he cannot specialize in every branch, and he realizes that the oral and plastic surgeon who is eminently trained can render a type of service which he desires his patient to receive. What would the general practitioner of dentistry think of the oral surgeon inserting inlays and other restorations?

In examining a patient, a history should be taken for the purpose of making a diagnosis, and this should be filed for future reference. I use a skeleton chart

which is divided and subdivided into various phases. By following a skeleton outline and recording the findings in a systematic manner, nothing of importance will be omitted. The routine is briefly as follows.

ROUTINE OF EXAMINATION

Patient's History.—This should consist of full name, address, telephone number, references, sex, age, habits, occupation, nationality, present complaint, etc., and a statement as to whether married or single. The correct name, address, telephone number and references are necessary in changing appointments, establishing the patient's financial status and rendering statements for services.

Sex.—The question of sex is significant in an examination. For example, women seem to be more susceptible to ranula, while leukoplakia and cancer attack men more frequently than women.

Age.—The age may aid materially in determining the causative factor. Sarcoma usually appears before 40, while cancer usually appears after 40 years of age. Vincent's infection usually attacks the adult. Acquired syphilis appears usually in the adult.

Habits. — Excessive use of tobacco (smoking, chewing or taking snuff) may produce a chronic irritation known as smoker's mouth or may cause leukoplakia. An individual with filthy oral habits is more susceptible to mouth infection, such as Vincent's disease, pyorrhea, leukoplakia, cancer, ranula, epulis and stomatitis, than the individual who practices scrupulous mouth hygiene.

Occupation.—Knowledge of the occupation may prove of inestimable value. The patient may handle lead in the capacity of a painter and develop lead poisoning; a paper hanger may develop arsenical poisoning; the individual who applies radium paint, for example, to watch dials, may develop radium poisoning, causing necrosis and disintegration of oral tissues and jaw bones; a chemist may develop oral disease from tasting various drugs or breathing gases in the laboratory.

Present Complaint of Patient.—After obtaining the preliminary information, we should ascertain why we were consulted. This will enlighten the diagnostician as to the location of disease. The patient's answer will be that he sought relief because a certain region was painful or swollen, and, by careful questioning, we can ascertain the degree, depth, intensity and character of the condition. This may lead us to suspect tic douloureux, impending alveolar abscess, infected impacted molars, empyema of the antrum, malignancy, etc. The patient may state that he sought relief because of the repeated appearance of blood in his mouth. This may be caused by gingivitis, arsenical, lead or phosphorus poisoning, pyorrhea, infection of the mucoperiosteum about the third molars, Vincent's infection, the presence of traumatized tissue or epulis, mechanical abrasion of soft tissues, etc. The patient may seek advice because of a swelling, hypertrophied gums, ranula, alveolar abscess, parotitis, infected or blocked Stenson's duct, swollen submaxillary or cervical glands as caused by osteomyelitis, periostitis, tonsillitis, periapical infection, syphilis, pharyngitis, maxillary empyema, actinomycosis, or the presence of dental cyst, sarcoma, epithelioma, etc.

History of Complaint.—Careful consideration should be given to every detail concerning the patient's complaint. Direct questioning will disclose many important factors, such as how the disease or lesion started; rapidity of growth of diseased part; tenderness to pressure, or freedom from pain; the character of pain, as to

whether lancinating, dull, boring or intermittent; the color of the lesion, and as to whether the lesion is becoming larger or smaller. If the lesion is malignant, a history is usually obtained of fairly rapid development, generally accompanied by pain, and, if located about the jaws, impaired function of jaws and soreness of teeth may be present. A benign tumor develops slowly and may be of several years' standing. It is usually painless, and does not cause anemia or loss of weight. Malignant tumors cause loss of weight, anorexia and anemia, and lower resistance.

An infected, impacted or unerupted lower third molar will cause false ankylosis, soreness of the temporomandibular joint on the affected side, a dull pain, boring in character, swelling of the tissues at the angle of the jaw, enlargement of the submaxillary glands and swelling and inflammation of the tissues about the third molar, with probably sufficient hemorrhage to color the saliva.

Medical History. — Questioning the patient with regard to previous attacks of illness, infections, operations or accidents may aid materially in establishing a diagnosis. Operations for paranasal sinus involvement or mastoiditis, rhinologic operations, removal of teeth; or the presence of enlarged salivary glands or submaxillary or cervical glands or swollen tissues about the jaws, throat, face and neck may afford valuable information. A history of chancre or mucous patch, skin rash or loss of hair is invaluable in making diagnosis of syphilitic gumma. The history of a cough of long standing may reveal pulmonary tuberculosis and assist in diagnosing oral tuberculous ulceration. A history of having abscessed teeth removed may prove valuable in determining the cause of pending arthritis, endocarditis, myocarditis, or high blood pressure, due to infected residual areas which were not removed when the infected teeth were extracted. The patient may give a history of having been treated for lead, arsenic, phosphorus or radium poisoning, the elapsed time having caused some form of necrosis. A dormant infection of the parotid gland due to injury or infection may become acute and cause a blocking of Stenson's duct.

The history of having a hypodermic needle broken during a deep block injection for an operation may assist in locating the broken fragment with the roentgen rays.

Family History.—Knowledge obtained through the family history may serve as a valuable aid in establishing a diagnosis. The predisposing causes embrace any inherited or acquired susceptibility to disease. There may be an inherited predisposition to arthritis, rheumatism or tuberculosis. An acquired predisposition depends on race, age, sex, occupation, habits and environment of the individual. Ascertain whether the parents are living; if living, whether they are well; if ill, the cause of their illness; if dead, the cause of their death. If the patient has brothers and sisters, ascertain whether they are living and well; and if dead, the cause of death. The family history is vital from the standpoint of syphilis, tuberculosis, sanitation, diet, occupation, environment and habits.

Observing Diseased Parts and Surrounding Tissues.—The trained eye observes every detail involving the diseased area. The trained diagnostician takes everything that he observes into consideration. Inspection and palpation of the affected part, adjacent tissues and glands should be carefully made. If the tissues are swollen, the tumor should be noted as to consistency, whether hard or soft, and as to color, size and shape. Palpation will

reveal whether it is attached to bone. If soft, fluctuation may be elicited, which denotes the presence of fluid. If the lesion be an ulcer, its size, shape, color, depth and the regularity or irregularity of its margins should be noted. Its consistency as to softness or hardness; whether it is painless or painful, and any tendency to hemorrhage are observed by palpation. If there is a discharging sinus, the character of the discharge is noted, whether serous, purulent, mucopurulent or sanguineous. The depth and origin of the sinus is determined by careful probing, or by filling the sinus with lipiodol and taking a roentgenogram. Trismus of the temporomandibular joints and soreness of the tissues about the angle of the lower jaw and throat may reveal an acute or even chronic inflammatory condition about the lower third molar region, which may be caused by the presence of an unerupted or infected third molar, an infected parotid gland or a broken hypodermic needle, or by tonsillitis. All lymph glands about the submaxillary and cervical regions should be noted as to enlargement and tenderness. Inspection should be made of teeth, tonsils, dental restorations, tongue, gums, palate and lips. Suspicious teeth should be examined by the roentgen ray and tested as to pulp vitality. Examination of gingival margins of teeth should be made for foreign bodies, such as a fragment of fish bone or toothpick, which might cause an acute infected pericementitis or periostitis. The presence in the antrum of an infected, broken tooth fragment may cause acute empyema.

Physical Examination.—Physical diagnosis is the art of discriminating between diseases by means of the eye, the ear and the touch. The signs thus ascertained are connected with changes or alterations in the form, density or condition of the structures within, and are known as physical signs. The physical signs are objective symptoms, which are elicited by inspection, mensuration, palpation, percussion and auscultation. Symptomatology is the study of the various symptoms and signs whereby the presence of disease is detected. They may be objective, when evident to the sense of the observer. Such symptoms are redness, swelling, high temperature, etc. Or they may be subjective, when the patient alone is aware of their existence. Such symptoms are pain, numbness, vertigo and nausea. The character of the pulse, temperature, blood pressure and respiration is a valuable diagnostic aid.

In obscure cases of disease involving the oral cavity, jaws and face, a general physical examination is imperative. It is not my intention to leave the impression that the dentist should be thoroughly qualified to make a general physical examination, because examination of the heart, lungs, arterial system and other parts of the body requires broad medical training in anatomy, physiology, physical and clinical diagnosis. It is desirable that the dentist be familiar with physical diagnosis to the extent of knowing that a thorough physical examination is indicated and that such examination may give valuable evidence in making a diagnosis of a maxillofacial or oral lesion. Many striking examples of the value of a general physical examination are herewith given. The persistent presence of oral hemorrhage and enlargement of lymph nodes may be caused by leukemia, and diagnosis is made from an enlargement of the spleen and the condition of the blood as shown microscopically. To treat the oral hemorrhage locally would prove futile. Local treatment of a chancre is not only valueless but also is of grave injustice to the patient. Treatment should consist of the intraven-

ous administration of neo-arsphenamin and application of mercury after suspected syphilitic infection is verified by the history and a positive Wassermann reaction.

Tuberculous ulceration of the oral tissues is usually secondary to pulmonary tuberculosis, which is determined by lung and sputum examination. If secondary to pulmonary involvement, it indicates tuberculous disease of long standing, which causes anemia, emaciation, anorexia, weakness, loss of weight, etc. Lesions occurring in the mouth, together with skin rash, are caused from such diseases as syphilis, lichen planus and scurvy. Tertiary lesions of syphilis such as perforated palate and degenerated nasal bones or nasal septum usually accompany syphilitic skin scars elsewhere on the body.

Oral diseases such as advanced pyorrhea, Vincent's infection, leukoplakia, dental cyst, abscess of the teeth and periapical dental infection may produce anemia, emaciation, anorexia, loss of weight and lowered resistance due to toxic absorption. Oral manifestations of disease may be either primary or secondary. If primary, and eradicated, the general systemic symptoms abate; if secondary, the eradication of its general cause will arrest the oral manifestations.

Laboratory Examination. — Laboratory examination consists of the following: microscopic examination of diseased tissue; microscopic and chemical examination of blood; growth of cultures; bacteriologic examination of specimens; inoculation of animals; roentgen-ray examination; urinalysis; transillumination. A bacteriologic smear taken from the infected area will determine the degree and type of organisms. A Wassermann test will give evidence of syphilis. Smears taken from infected areas and cultures grown from infected material may reveal the causative factor. Examples of this are: the spirillum and fusiform bacillus causing Vincent's infection; *Spirochaeta pallida* causing syphilis; *Streptothrix bovis* or actinomyces causing actinomycosis; and staphylococcus and streptococcus infections. An oral tuberculous ulcer may not be diagnosed until guinea-pigs have been inoculated with the suspected infected tuberculous scrapings. Under block anesthesia, a tissue specimen taken from a new growth or from an ulcer for microscopic examination is valuable in arriving at a diagnosis. Roentgen-ray examination is invaluable in making a diagnosis of bone lesions and infection of the teeth. The blood picture in suspected leukemia is essential to a diagnosis.

Pyorrhea will not yield to local treatment if the patient is suffering from diabetes. In such a case, urinalysis discloses the presence of sugar. Urinalysis may reveal sugar when the patient is suffering from furuncle or carbuncle. The coagulation blood test is a safeguard with the suspected hemophiliac. All branches of the pathologic laboratory are invaluable to the oral surgeon in establishing a diagnosis, for two principal reasons: in determining, first, the nature of the lesion and, secondly, the resistance and general condition of the patient. The blood picture may be indicative of anemia, and it determines whether or not the patient is a good surgical risk.

CORRECT DIAGNOSIS THE BASIS OF EFFICIENT SERVICE

Efficient treatment or surgery cannot be rendered without definite knowledge of the causative factor. Rational treatment is based upon the scientific facts. It is not necessary to give every patient as complete examination as outlined above, but when cases demand it, every known diagnostic measure should be employed, because

some cases baffle the most skilled diagnostician, even when exhaustive study and examination are given. Many mouth lesions are easily diagnosed, and, for such cases, the trained operator uses judgment as to the extent of examination, such as heart, blood pressure, metabolic, urine, blood and bacteriologic. Diagnosis of diseases of the jaws and oral tissues implies a complete, exact and comprehensive knowledge of the phenomena under consideration, as regards the origin, seat, extent, nature and general systemic involvement. A direct diagnosis is made when the pathologic condition is revealed by a combination of clinical phenomena, or some one or more pathognomonic symptoms. A differential diagnosis is the result when the diseases resembling each other are called to mind and the less probable ones eliminated. A diagnosis by exclusion is made by proving the absence of all oral diseases which might give rise to the symptoms observed, except one, the presence of which is not actually indicated by any positive symptoms.

Acute inflammatory conditions involving the submaxillary region are in some cases difficult to diagnose. The greater percentage of those acute inflammatory reactions are due to extension of infection from diseased teeth or tonsils. Pus from an alveolar abscess involving one of the teeth in the lower jaw may perforate the alveolar plate and gain entrance into the oral cavity, or the pus may perforate the inferior lateral part of the alveolar plate, separating the periosteum from the bone, burrowing through the soft tissues to the submaxillary region and generally causing a pointing of the skin or actually breaking through the skin.

Infections of the teeth, periosteum and bone produce inflammatory changes in the surrounding tissues, which cause a trismus of the lower jaw. The trismus is of diagnostic value in determining whether the submaxillary swelling is due to pus from dento-alveolar infection or from some local condition in the mouth. If trismus is absent, other causes should be sought, such as a foreign body causing pericementitis, tonsillitis, ranula, tuberculous gingivitis, leukemia, salivary gland infection, syphilitic ulcer, broken hypodermic needle and Vincent's infection.

Obstruction of Wharton's duct by a salivary calculus may cause an inflammatory submaxillary swelling. In many cases, this condition is mistaken for a lymphadenitis caused from infected teeth. Careful questioning may reveal repeated attacks, usually occurring during or immediately after a meal. The presence of food in the mouth stimulates gland activity, which increases swelling and pain. Palpation reveals a painful swelling in the floor of the mouth, near the median line, caused by occlusion of Wharton's duct, and a tender circumscribed submaxillary swelling. Diagnosis of a calculus is confirmed by roentgen-ray plates which are exposed from below upward, and from a lateral position. Trismus of the temporomandibular joint is usually negative in ranula, and usually positive in submaxillary inflammatory swellings from dento-alveolar abscess.

ACUTE ALVEOLAR ABSCESS

Dento-alveolar abscess results from a carious tooth or broken root fragment. When the public is educated to the importance of periodical examinations and the practice of mouth hygiene, there will be fewer dento-alveolar abscesses. Primarily, the pain from an acute abscess is referred to the affected tooth, but the rapid spread of inflammation to the surrounding tissues produces neuritis, pericementitis and periostitis, causing pain in adjacent teeth when percussed. Forma-

tion of pus and gas causes swelling of the tissues, and a burrowing of the pus through the tissues offering least resistance. The pus may escape along the diseased tooth, but most frequently it escapes through the tissues and is accompanied by inflammation and swelling. Pus from an abscessed upper tooth may escape through the labial or buccal alveolar plate, through the palate, or into the antrum; or it may burrow through the soft tissues, involving a lymphatic gland. If the first prominent swelling is due to involvement of the lymphatic glands which drain the upper teeth, the most marked swelling in this region may be mistaken for an infection of the parotid gland, or from a diseased lower tooth. The pus may burrow beneath the periosteum and discharge through a sinus a short distance from the involved tooth, on the gum or through the mucous fold. The periosteum may be stripped from the maxilla, or the pus may burrow between the mucous membrane and skin and rupture the skin of the cheek or beneath the lower jaw. Lymphatic glands are involved early, but usually do not suppurate.

Complications arising from dento-alveolar abscesses are: periostitis, cellulitis, osteomyelitis, maxillary empyema, lymphatic gland degeneration, necrosis and deformity. Many dentists are baffled as to the logical treatment for an acute dento-alveolar abscess accompanied by extreme inflammation, swelling, lymphatic gland involvement and high temperature. If the dentist operates and the infection spreads or an osteomyelitis develops, he is blamed for operating. If he does not operate and complications arise, he is blamed for not extracting the tooth. The offending tooth which is the causative factor should in most cases be removed. Judgment must be used as to the logical procedure. If the tooth is not removed, free drainage must be established by making an incision to the bone. Free drainage may prevent osteomyelitis, antrum infection, lymphatic gland involvement and other possible sequelae. If infection is in the fulminating stage in which actual suppuration has not begun, with the patient's resistance low, the removal of the tooth is contraindicated. If pus has actually formed, the removal of the tooth is indicated because its removal allows the pus and gas to escape and prevents further burrowing through the tissues to a distant point. Curettage of the socket should never be performed immediately after removal of an abscessed tooth as such a procedure may cause dissemination of infection. Whenever possible, drainage should be established intra-orally to avoid a scar on the skin. If pus has burrowed beneath the periosteum and pierced the soft tissues, causing a pointing of the skin, in all probability an extra-oral lancing is indicated. If such is the case, the incision is made in the least conspicuous place, which is parallel to the lower border of the mandible. After free drainage is established, most dento-alveolar abscesses rapidly subside. In some cases, osteomyelitis develops, causing extensive bone destruction. When the periosteum is stripped from the bone and subjected to pus, contact with the vitality of the underlying bone is destroyed, which may cause bone necrosis. Osteomyelitis in the jaw of a child will destroy the permanent tooth germs. Curettage in the acute stage is both a dangerous and a destructive procedure. Free drainage, efficient irrigation, medication and removal of sequestra as formed are the logical procedure. Usually, bone destruction is limited. It will in most cases regenerate, deformity and impaired function being prevented. Radical surgery for removal of diseased bone before the formation of a sequestrum re-

tards bone regeneration and causes malocclusion of teeth and distortion of the face and jaws. If large sequestra are allowed to form, dental splints for the teeth may be valuable to prevent malocclusion and collapse of the remaining parts of the jaw until nature has filled the defect by regeneraton of new bone. Extensive bone destruction may require several plastic operations and extensive orthodontic treatment.

VINCENT'S INFECTION

The most common form of sore mouth and one of the greatest problems of dentistry is Vincent's infection. This oral disease is endemic and epidemic, and no class or community is immune to attack and its destructive action. No mouth, regardless of vital teeth and healthy oral tissues, and scrupulous oral hygiene, is barred from its ravages. Its etiology is still in doubt, but it is thought to be caused by *Bacillus fusiformis* and *Spirochaeta refringens*. Diagnosis is made microscopically and clinically. The clinical picture is that of a mottled red area usually presenting a central whitish or grayish patch or zone which may be single, multiple or diffuse. It is highly contagious in the acute stage. The chronic type may prove difficult to diagnose and to eradicate. The chronic form may be mistaken for periodontoclasia. The primary attack of Vincent's infecton is usually on the gingival tissues. The causative bacterial agents seem to live in pockets or about the necks of the teeth. I have never observed Vincent's infection in an edentulous mouth. If it is not treated, rapid tissue destruction takes place. There may be fever, swollen submaxillary glands, fetid breath, increased saliva and metallic taste. The gingival margins of the gums undergo rapid dissolution from ulceration and necrosis. The infection penetrates the tissues rapidly, causing destruction to the alveolar process and extreme soreness and loosening of the teeth. The ulcerations may be covered with a pseudomembrane, and its removal leaves a bleeding surface.

In pyorrhea alveolaris, when staphylococci and streptococci are present, pus can be pressed from the pockets; but in Vincent's infection, the tissues disintegrate rapidly and usually without pus. The virulency and rapidity of this infection and tissue destruction cause severe pain in the gums, alveolar process and teeth, making mastication of food unbearable. The infection may extend to the lips and produce an ulcer, or it may involve the tonsils and pharynx.

The predisposing factors to this disease are filthy mouths, inflamed gums, syphilis, decayed and broken teeth and bad dentistry, causing irritation. Excessive smoking, causing inflammation of the oral mucous membrane, may be a vital etiologic factor. Vincent's infection must be differentiated from tuberculous gingivitis, syphilis, leukoplakia, malignancy, pyorrhea complicated with inflammatory reaction, diphtheria and various forms of stomatitis and periodontoclasia.

During the World War, various groups of soldiers were infected, which proved rapid spreading by contact. It was more prevalent among the soldiers confined in the trenches. This disease has become so prevalent and the number of cases is so greatly on the increase that it should be placed among the reportable diseases and preventive measures should be inaugurated. Vincent's infection may be the primary cause of digestive and stomach disorders and anemia. If not arrested, a mixed infection of extreme virulency may result, ending in gangrenous stomatitis, noma, septicemia, etc. This

disease should never be treated without the use of rubber gloves and strict observance of aseptic measures. All instruments should be sterilized by boiling. All receptacles, cotton, swabs, gauze and towels should be burned, or thoroughly sterilized, to prevent the infecting of others.

This disease can be acute, subacute or chronic. With the chronic type, there are many innocent carriers. After sufficient treatment, it may recur, owing to retention of the typical spirillum in the tonsils or isolated pocket. Microscopic examination should be made of smears taken from suspicious mouth lesions at frequent intervals after apparent eradication by efficient treatment, to prove definitely that there is no recurrence of the infection. The frequency of attacks on the tonsils and oral tissues by this disease should be borne in mind by the physician and the dentist. This disease is one of the greatest problems concerning dentistry today, and its prevention and the education of the public regarding it is a serious and vital duty confronting every practitioner.

TYPES OF TRIGEMINAL PAIN

The trigeminus is subject to two types of neuralgia; first, the symptomatic type, or atypical neuralgia; and second, the spasmodic paroxysmal type, or tic douloureux.

Atypical neuralgia is caused by pathologic lesions and yields to a different treatment from that of tic douloureux. The superior and inferior maxillary divisions are more susceptible to the so-called rheumatic influences, while the ophthalmic division is more susceptible to septic poisoning. In most cases, symptomatic pain caused from the foregoing condition will be arrested with proper surgical or medical treatment.

ETIOLOGY OF TRUE TRIGEMINAL NEURALGIA OR TIC DOULOUREUX

The specific etiology is unknown. Microscopic examination of sections of the gasserian ganglion and nerve branches has revealed nothing definite. It has been my observation in treating these cases that arteriosclerosis is frequently present, the patient giving a history of some infection and neuralgic pains of the face. From these observations, I am of the opinion that tic douloureux is caused by some toxic process, bringing about degenerative change in the gasserian ganglion. It appears to be a special disorder, dependent on some pathologic change in the nerve itself.

In some cases, neurotic changes have been observed, such as deposition of connective tissues and increased vascularity, but the cause of this may be the result of former treatment, such as injections of alcohol. There may be impingement on the gasserian ganglion or nerve branch by a tumor, an exostosis or cicatricial tissue.

Horsely was of the opinion that the disease is an ascending neuritis caused by dental caries, but conclusive proof has never been established. The symptoms of tic douloureux do not simulate those of neuritis. Frazier is of the opinion that it is due to sclerosis of the gasserian ganglion. Dana has advanced the theory that it is caused by a degenerative process of the gasserian ganglion. Patrick states that the pathologic changes which have been found do not afford sufficient proof to justify making a definite statement regarding its etiology.

Others have advanced the theory that it is due to an inflammatory condition of the ganglion, and, in order to support their contention, state that the symptoms of tic douloureux followed an attack of epidemic encephalitis. This contention was not proved, as microscopic examina-

tion of sections of the gasserian ganglion failed to disclose any histologic change.

Adson observed that tic douloureux is frequently associated with general sclerosis or cerebrosclerosis, but less frequently with multiple sclerosis, together with other neuralgic pains, i. e., atypical neuralgic pains involving the face, and sciatic and intercostal neuralgic pains. In view of these observations, Adson states that he is convinced that the etiology of tic douloureux is similar to the etiology of the above named diseases; and since the pain is not relieved by removal of the foci of infection, it seems logical to assume that the lesion at the time that the neuralgic pain develops is not acute, even though one suspects it to be, owing to some sclerotic lesion which has developed within the gasserian ganglion, representing a postinfectious result.

SYMPTOMATIC PAIN IN ATYPICAL NEURALGIA

As symptomatic neuralgic pains must be differentiated from those of tic douloureux, a complete history and thorough examination, with close observance of the patient, must be given. Conclusive points in making a diagnosis are: first, the duration of the disease and, second, the duration and character of the pain. If the neuralgic pain is caused from infection of the antrum, frontal sinus, teeth or tonsils, impacted, unerupted or malposed teeth, pulp stones, pus infection, malaria, tumors, or any other acute condition, it will, if observed over a sufficient time, reveal characteristics which will differentiate symptomatic neuralgia from tic douloureux. If the pain is caused by any of the foregoing conditions, it generally remains as a continuous dull, boring ache. The onset of pain usually attacks the patient slowly, and the pain is mild, the degree and intensity increasing in accordance with its cause and the progress of the pathologic derangement. If caused by the presence of an impacted lower third molar or pulp stones, the onset will be slow and less severe than if it is caused by some acute infection. The pain of symptomatic neuralgia may be increased in intensity when the patient lies down. It may prevent sleep and is more or less constant. It is not paroxysmal in type, but is continuous and diffuse in character and may extend beyond the median line or involve tissue not supplied by the trigeminal nerve.

SYMPTOMS OF TRUE TRIGEMINAL NEURALGIA OR TIC DOULOUREUX

Tic douloureux is characterized by agonizing shooting pains, usually starting in the nasal region, cheeks or lips, and radiating through the teeth and jaws to the orbit, forehead, temple, ear and base of brain. In the beginning, the individual may attribute the pain to toothache and seek relief from his dentist.

Each attack may last from a second or two, with sharp lancinating pain, to a period of one to two minutes of pain, which is agonizing, lancinating, sharp, shooting and characterized by a burning sensation.

Paresthesia of the affected side of the face and an area called the "trigger zone" is present. A "trigger zone" is a hypersensitive circumscribed area of skin, usually about 2 cm. in diameter, which may, or may not, be located in the skin supplied by the affected nerve. In mandibular nerve involvement, it is commonly located just laterally to the ala of the nose. Increased lacrimation, discharge from the nose, spasmodic contraction of the facial muscles and tongue may occur, with the patient groaning, slapping and rubbing the face and manifesting extreme agony.

Successful treatment depends on correct diagnosis.

In ruling out symptomatic neuralgia, one of the most important aids in arriving at a diagnosis is roentgenograms of the teeth, osseous structures, antrums and accessory sinuses. Transillumination is of some value. A Wassermann test should be made to rule out syphilis. In most cases, the onset of symptomatic neuralgia is gradual, this depending, however, on the nature of its cause. If it results from an alveolar abscess or frontal or maxillary sinus infection, the onset will be more rapid, the pain more severe than if caused from a tumor, pulp stones, foci of infection located in the teeth or tonsils, or a cyst or sclerosis of bone following tooth extraction. Symptomatic neuralgic pain may be caused from toxic absorption, neuritis, irritation of the terminal nerve endings or pressure on a sensory nerve. Palpation over the affected area usually reveals tenderness, but no "trigger zone." If caused from some dormant condition, usually there is no tenderness to pressure. As a rule, the pain is diffuse, and it may radiate across the median line and extend to the neck and shoulder. It is generally augmented on retiring and causes loss of sleep. The pain is generally constant. Remissions may occur, but the periods between attacks are different from those of tic douloureux.

Clinically, symptomatic neuralgia may somewhat simulate tic douloureux, and it may prove difficult to establish a diagnosis. In tic douloureux, the pain appears in cycles, with periods of remission. It is confined to tissues supplied by the fifth nerve and does not cross the median line. At first, the patient may take little notice of it, thinking it may result from a carious tooth, or that he has taken cold, giving no further thought to it until a second attack occurs. At this time, he generally seeks relief from his dentist or his physician. He may have carious teeth filled, and pulpless teeth, or even all the teeth, and the tonsils removed. Such operations, if the patient is afflicted with tic douloureux, will prove of no avail. Quite true, restorative dental operations, removal of infected teeth and tonsils and the draining of a sinus may apparently seem to be the causative factor, and the completion of such operations together with the apparent cessation of painful paroxysms is indeed a happy coincidence. But in the not distant future, the patient experiences another attack.

Primarily, the pain may be located in one branch of the fifth nerve, but later a second branch or all three branches may become involved. A paroxysm may be elicited by taking food, moving the tongue, brushing the teeth, drinking from a glass, touching the face or feeling a draft of cold air, or it may be caused by the slamming of a door. In taking food or drink, the paroxysm is more likely to be elicited if the substance taken is either sweet or sour, but the fact that the food is hot or cold is not a factor in bringing about the paroxysm. Therefore, it should not be confused with pulpitis.

Usually, the pain starts in one definite spot, the "trigger zone," radiates to a certain location and involves only the side of the starting point. Invariably, during a paroxysm, the patient suddenly slaps his hand heavily over the affected part and begins a vigorous massage, all the while smacking the lips and drawing the mouth to the opposite side. In severe cases, the patient may refrain from taking nourishment for fear of another attack. Depression of spirits is present in many cases, because of intense agony, no doubt the severest pain nature could devise. The patient experiences more difficulty during

the winter, and may escape an attack during the summer months.

I have observed only one patient with bilateral tic douloureux. This condition is not associated with headache. Therefore, the history of periodic attacks of radiating pain to the orbit, and over the forehead, such as are present in migraine, rules out tic douloureux.

Sphenopalatine neuralgia, as described by Sluder, is a pain at the root of the nose, about the eye and upper jaw, extending beneath the zygoma to the ear, and taking on the form of an earache. The pain is severest distally from the mastoid, extending backward to the occiput and neck, and may extend to the shoulder and arm. The patient may describe the pain as an "aching" in the throat and pain inside the nose. The pain is not so severe as that of tic douloureux, and is not paroxysmal. Sphenopalatine neuralgia is ruled out by blocking the sphenopalatine ganglion with procain.

Glossopharyngeal neuralgia is located in the region of the glossopharyngeal nerve, and the "trigger zone" is in the tonsillar region. The pain is intermittent and paroxysmal, and if it is caused from involvement of the glossopharyngeal nerve, anesthetizing the throat will block the "trigger zone." A paroxysm, if one can then be elicited from the face, indicates trigeminal nerve involvement and rules out glossopharyngeal neuralgia.

REFERRED PAIN

Location of the condition causing referred pain may be difficult. Pain may be produced by either a distant or a local condition; for example, an irritated pulp may cause pain in its immediate region or at a distant point, as neuralgia in the ear or occipital headache. This phenomenon is due to the direct relationship of nerves. An important diagnostic feature, if the pain is referred, is the fact that the tissues in the region of interpretation are not sensitive to pressure; but if the pain is not referred and is caused by some inflammatory process, the tissues in the area of interpretation are painful to pressure.

Referred pain may be caused by pressure, injury, trauma or irritation of a sensory nerve at a distant point. In such a condition, stimuli are transmitted over the sensory nerves to a remote part and interpreted as pain. A common example of referred pain, undoubtedly met by every dentist, is as follows: A patient complains of pain in a certain tooth. On examination, the tooth is found to be free from caries or irritation, and further examination reveals a carious cavity in the opposite jaw.

In order to illustrate referred pain, I will use the sensory root of the fifth nerve, which is situated between the gasserian ganglion and its deep sensory nucleus. The nerve fibers forming this large sensory root end in a sensory nucleus which extends from the pons through the third cervical segment of the spinal cord. At this point, the sensory branches of the nervus trigeminus are in close relation. Therefore, pain stimuli may arise, owing to some pathologic condition in an accessory sinus, nasal cavity, eye, tooth, jaw, face or ear, and be interpreted as pain at a distant point, such as the temple, occiput or other region, rather than the actual point of irritation.

Frequently, pain stimuli, nasal, ocular, aural or dental, interpreted in the occipital region, are anatomically explained by the central contiguity of the ophthalmic, maxillary and mandibular afferent sensory terminals, to those of the upper three cervical roots, located in the region of the descending trigeminal nucleus. It is a well-known fact that a pathologic condition involving the tissues supplied by the

nasociliary nerve may produce neuralgic pain in the forehead and scalp region.

Other striking examples of referred pain are neuralgia in the ear or a frontal headache caused by the presence of carious, impacted or malposed teeth, pulp nodules or alveolar abscesses, infection of the antrums or frontal sinus, or eye strain.

There is no question that antral, frontal sinus and ocular disease, alveolar abscesses or decayed, infected, impacted, malposed or unerupted teeth, necrosed bone and dental cysts have played an important rôle in the symptomatic type of neuralgia.

MAXILLARY EMPYEMA

The characteristic symptoms of maxillary empyema are an increase in temperature, pain, a feeling of fullness in the head and an abundant discharge of fluid, watery mucus or mucopurulent in character from the nostril of the affected side. There are tenderness and edematous swelling of the face, and, in many cases, the thin bone may crepitate under pressure. The pain is often described by the patient as that of extreme pressure or neuralgia. The presence of pus is one of the most important factors, and a simple test will, as a rule, prove whether or not pus is seeping from the antrum. This is accomplished by inserting an applicator into the nose and wiping the mucous membrane in the middle meatus, then having the patient lean forward with his head between the knees turning his head sideways, with the affected side upward, and retaining that position for several minutes. If pus is present, it will in all probability escape through the ostium. With the patient in an upright position, a nasal applicator is introduced and the middle meatus examined for pus. In all cases, the operator should use a nasal speculum, and, by illumination, examine the mucous membrane at the location of the ostium maxillare for pus and for incrustations of pus on the hair follicles of the anterior nares. In acute cases, the ostium may be completely blocked, which adds greatly to the intensity of the pain and the severity of the symptoms. The nasal wall may be seen bulging. Neuralgia of the infra-orbital nerve and its branches may produce an exophthalmus and tenderness in the alveolar process and teeth. The teeth may feel irregular, and occlusion may cause pain. In some cases, there is no pain because the exudate is draining through the ostium maxillare when the patient lies down.

Factors to be considered in diagnosis are: 1. Pain, swelling and tenderness over the affected area. 2. The presence and recurrence of pus in the middle meatus. Its absence is not conclusive evidence that a maxillary sinusitis does not exist. R. Boyd Bogle states that, in some cases, pus may be present in the antrum with no discharge from the nose, the pus being confined within the antral lining. 3. Pain in the alveolar process and elongation of the teeth in the affected antral region. 4. Fullness in the roof of the mouth. 5. A difference in the two sides of the face, due to edematous swelling on the affected side. 6. Headache and a disagreeable taste in the mouth on arising in the morning, due to draining of pus into the throat. 7. Iridiocyclitis, impairment of vision, conjunctivitis and a feeling of fullness in the orbit.

Transillumination is a valuable adjunct in diagnosis. It reveals a diminution of light transmission on the diseased side as contrasted with the normal rosy color under the eye on the normal side. The pupil on the normal side will be visible, while on the diseased side, the pupil will be invisible owing to opacity or nontransmission of light. Transillumi-

nation is not always a positive means of diagnosis, as there may be an infiltration process of the lining over the floor, without engorgement, or there may be in the bone surrounding the antrum a difference in density which affects translucency. Transillumination, when combined with roentgen-ray findings, is a valuable diagnostic measure.

Roentgen-ray findings should not be taken as conclusive evidence that antrum infection is present, but should be considered with transillumination and the clinical findings. The roentgen-ray is valuable in revealing whether we are dealing with maxillary sinusitis alone or a pansinusitis. It may also reveal septums in the antrum and, more particularly, dental disease, cysts, etc.

Transirrigation by insertion of a small trocar into the antrum through the thin naso-antral wall at the anterior-inferior portion of the inferior meatus is a valuable diagnostic measure, because, if pus is present, it can be aspirated. The antrum is irrigated with a return flow cannula and irrigation needle, and a return of turbid fluid indicates the presence of pus.

DIFFERENTIAL DIAGNOSIS

Empyema of the maxillary sinus must be differentiated from symptoms caused by the presence of tumors, maxillary cysts and impacted upper third molars causing pressure and pain; osteomyelitis of the jaw; acute alveolar abscess; fracture of the maxilla; periostitis; syphilis, and actinomycosis.

Syphilis.—The presence of oral manifestations of syphilis is of vital importance to the oral surgeon and dentist. The primary lesion, the chancre, may be located on the lip, palate, tongue, oral mucous membrane or tonsil. This primary manifestation of syphilis generally appears as a single lesion. It appears at first as a small papule, slowly becoming larger and breaking down into a round or oval ulcer about 15 mm. in diameter. Its margin is elevated, and it has an indurated base. It is seldom painful. The secondary stage is accompanied by a general adenopathy, fever, joint pains, loss of hair, anemia, sore throat, headache, mucous patches and skin rash. The moist syphilitic lesions in or near the mouth are dangerous. Clinical diagnosis is difficult during the primary stage. The chancre usually appears within three weeks after contact with infection. If the initial lesion is on the lip or within the mouth, the cervical and submaxillary lymph glands are swollen but painless. A chancre must be differentiated from other lesions, such as herpes, traumatic ulcer, tuberculous ulcer and epithelioma. Examination of smear from suspected syphilitic chancre by dark-field illumination may reveal *Treponema pallidum*.

Diagnostic factors during the secondary stage are: the history of a primary lesion, joint pains, loss of hair, skin rash and the presence of mucous patches in the mouth, on the tongue, on the tonsils, etc. Mucous patches are grayish white, oval, moist, slightly elevated and covered with a dirty gray membrane which leaves a bleeding surface when removed. They must be differentiated from simple ulcers, which are painful to pressure and have reddish borders, no other lesions being present which accompany syphilis.

The dentist should be able to recognize from the clinical history and observation of the affected parts, pathologic lesions caused from tertiary syphilis. A history of chancre, sore mouth, body rash, loss of hair and miscarriages is valuable diagnostic evidence. A perforated palate is generally syphilitic. Gumma of the tongue may be mistaken for carcinoma

because both diseases start with a lump, increasing fairly slowly in size, and breaking down into an ulcer. In cancer, the tongue is painful to movement or palpation, and the submaxillary glands are enlarged. In gumma, palpation does not produce pain, the glands may not be involved and usually other evidence of syphilis is obtained from the history and the clinical appearance.

Tuberculosis. — Tuberculosis of the face, mouth, nose and throat is usually secondary to pulmonary tuberculosis. Lupus most commonly attacks the skin of the nose, cheeks and angles of the mouth. It appears on the skin in a number of small reddish areas about 5 mm. in diameter. Pressure produces paleness and these areas may become brownish or yellowish. Ulceration rapidly follows. The skin lesions must be differentiated from psoriasis and epithelioma. Lesions of psoriasis do not ulcerate or extend as deeply into the tissues as does lupus. An epithelioma is usually singular, elevated above the skin, and of offensive odor when ulcerated, and the lymphatic glands are swollen and hard.

A tuberculous ulcer of the oral tissues is painless at the beginning but later becomes tender and extremely painful. The ulcers are not elevated and the margins are sharp. Diagnosis is established from clinical appearance, general physical examination, serum tests and the presence of tubercle bacilli.

Actinomycosis.—This chronic infective disease is caused by the actinomyces or ray fungus, and usually attacks the jaw, oral tissues and face. The causative agent usually enters the oral tissues through an abrasion, tooth socket, pyorrhea pocket, etc. The primary lesion appears as a small, tender nodule with a smooth surface. The nodule enlarges slowly and the skin becomes purplish. The skin surface breaks down, with formation of a sinus discharging a thick pus.

Diagnosis is made from microscopic examination of the discharge for the ray fungus and sulphur granules. The primary lesion tends to heal, but others rapidly form with discharging sinuses.

Stomatitis.—A generalized inflammation of the oral mucous membrane generally accompanies Vincent's infection. Stomatitis arises from oral sepsis and irritation of the tissues, the use of chemicals, bad dentistry, pyorrhea, dento-alveolar abscesses and tonsillar or nasal sinus infection. Stomatitis caused from the foregoing factors and not associated with Vincent's disease is, as a rule, slow in yielding to treatment, even after the causative condition is eliminated. Reddish or whitish areas, accompanied by inflammation and soreness, are the principal clinical features. Septic stomatitis may be mistaken for leukoplakia owing to the presence of whitish patches. In all cases of stomatitis, microscopic examination should be made to confirm or rule out Vincent's infection.

Leukemia.—In some cases of leukemia, the gums, both upper and lower, are in a state of inflammation and may be hypertrophied so badly as to cover the major portion of the crowns. I have had experience with two such cases. The condition must be differentiated from hypertrophy of the gums caused by chronic irritation, oral infection, stomatitis and sarcoma. Microscopic examination of the blood confirms the diagnosis of leukemia.

Broken Hypodermic Needle.—A fragment of broken hypodermic needle which has been left in the tissues in attempted deep block injection may give rise to discomfort, pain and possible complications owing to migration of the fragment and involvement of some important tissue. If the needle was sterile when broken, infection will not prevail. Diagnosis is made

from a history of attempted deep block anesthesia and from roentgenograms taken at right angles. Mastication, deglutition or certain movements of the neck or head may cause sharp pain, due to placing needle under tissue tension. A broken needle should be removed to avoid migration and possible pathologic sequelae.

The Infected Pulpless Tooth. — The deadly effect of the presence of the infected pulpless tooth on the vital organs of the body and so on the general health is well known to all who are familiar with modern medicine and dentistry. Focal infection, as a theory, has been relegated to the archives of forgotten events. Its ravages against health have been proved both clinically and bacteriologically, and are known and accepted by the profession and scientists throughout the world. A focus of infection about the root apex or within the tonsil is a circumscribed area in which pathogenic micro-organisms multiply. It is a point at which a definite pathologic process has been established, a center for distribution of toxic or bacterial agents which may produce changes in the structure and function of any organ or tissue of the body, this depending on the resistance of the host to the amount of destruction that may take place. The condition may be acute or chronic, transient or persistent, this depending on the individual immunity or the natural defense of the body against bacterial invasion. The invading organisms may be of any type, but those in which we are especially interested are *Streptococcus viridans* and *Streptococcus hemolyticus,* which are found in infected teeth and tonsils. The definite establishment of facts dealing with mouth infection and its relationship to systemic disease has placed a great responsibility on the diagnostician, oral surgeon and dentist. When statistics show that the great majority of pulpless teeth are infected, is it not true that a great responsibility is placed on the diagnostician? Diagnosis of disease caused from focal infection cannot be based upon roentgenograms alone because the degree or virulency of infection cannot be determined or measured by the roentgen ray. Periapical tissues may appear normal in the roentgenogram, and yet a periapical infection may exist in the most virulent form. The roentgen ray shows variations in tissue density and not focal infection.

If the roentgen ray does not show a shadow in the periapical region of a pulpless tooth, this does not signify by any means that the tooth and periapical region are not diseased. A well-defined "walled off" area may be innocent, while the acute or subacute infection may exist for an indefinite period, and the infection may be disseminated into the surrounding periapical alveolar process. With such a condition, rapid absorption takes place. Beware of the nonencapsulated areas.

A pulpless tooth cannot be ruled out as innocent by roentgen-ray findings alone, but the roentgen-ray findings must be combined with physical and laboratory examinations, which should be given by one thoroughly trained in diagnostic measures.

Root-canal filling technic has not as yet sufficed to prevent periapical infection. In a vast percentage of cases, a pulpless tooth, the root canals of which have been treated and filled in accordance to the latest methods, if extracted and examined within a few months after the root canals have been filled, will be found infected. A pulpless tooth should be regarded with suspicion and removed when proved guilty by modern diagnostic means such as roentgenograms, vitality tests and physical and laboratory examinations.

When should pulpless teeth be removed if a patient is suffering from auto-intoxication and the roentgen-ray findings are negative? They should be removed after thorough and exhaustive physical and laboratory examinations for other possible foci have been made by a trained diagnostician and found negative. Patients suffering from focal infection usually present some of the following symptoms: anemia, anorexia, general malaise, headache, low blood pressure, progressive loss of weight, joint pains, stiffness of muscles, irregularity of the heart and fatigue. The location of a focus of infection in the borderland case is difficult and may baffle the trained diagnostician, but when the cause is finally determined and eliminated, the results are indeed gratifying.

Precancerous Oral Lesions. — Every dentist and every physician should be able to recognize oral lesions which may prove to be a beginning malignancy. Bloodgood says that early recognition and treatment of precancerous mouth lesions assures a cure. This means that an early diagnosis is imperative. Early diagnosis can be accomplished in two ways; first, the dentist or physician must be able to recognize precancerous lesions and, secondly, the public must be educated to seek medical advice for any soreness or swelling that persists for several days. Often, the dentist is first consulted and a grave responsibility rests on him, because on his advice and treatment the life of the patient may depend, if he is dealing with a precancerous lesion. Conservation of time is vital because the time consumed from inefficient treatment based upon an incorrect diagnosis allows metastases to take place; which makes it more difficult to eradicate the condition when a correct diagnosis is made. A few weeks' delay of proper treatment may mean the life of the individual. Any new growth, ulcer or swelling in the oral cavity persisting for more than a few days should be looked on with suspicion. In the past, such oral lesions as leukoplakia, epulis, syphilitic scars, glossitis, fissure of the tongue, hypertrophied papillae of the tongue, and hypertrophied bleeding gums were not looked on with any grave concern, but today we know they are precancerous in many instances. The epulis which was considered innocent is now regarded with suspicion and is treated by radical removal. Leukoplakia, which may be caused from irritation, bad dentistry or smoking, makes its appearance on the inside of the check or tongue as a whitish patch, and is regarded as a forerunner of cancer. Syphilitic scars may become malignant. Irritation of the oral mucous membrane or tongue from bad dentistry may produce malignancy.

The frozen section and the roentgen ray are invaluable in making a diagnosis, and without them, early efficient surgery cannot be accomplished.

Time will not permit the discussion of many other oral manifestations of disease. I hope that the subjects herewith discussed will illustrate the importance of the diagnostic function of the dentist to the oral surgeon. The general practitioner of dentistry or medicine should be his own judge as to whether he is qualified to diagnose, operate and treat certain oral diseases from the beginning, taking all responsibility, or should refer the patient to a specialist.

Wilshire Medical Building.

DIAGNOSING AND FILING THE ROENTGENOGRAM*

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EVER since we have used the roentgen rays, we have been very much dissatisfied with our methods of diagnosing and filing the roentgenogram. During these years, we have been constantly changing our diagnostic technic, as new ideas have been presented by various workers in this field, but never have we been entirely satisfied with our procedure.

At first, we were foolish enough to take a glance at the film, and throw it away after making a snap diagnosis. Before long, it dawned on us that this was a very poor procedure, that the roentgenogram should not only be saved, but that a record of the diagnosis should also be kept. Having at hand a filing cabinet that was not being used, we began placing the films in small envelops, which were filed by number. The diagnosis was then recorded in long hand in a large blank book under the proper number. This system proved very unsatisfactory, mainly because it took so much time and was too scattered.

A recent book dealing with dental economics[1] afforded a better idea for making and recording a diagnosis. This involved using a separate card for the diagnosis and attaching it to the record card of the patient with a paper clip. On this card was a space for the name of the patient, the date and also a list of possible diagnostic findings. The technic of diagnosis consisted of taking one of these possible findings at a time, going through all of the films for this finding, and recording it on the card by the number of the tooth involved. The next on the list was treated in the same manner, and in this way, the diagnosis followed a definite procedure, making it difficult to overlook anything covered by the list. The list was as follows: teeth out; alveolar absorption; apical infection; hidden caries; incomplete root fillings; teeth O. K.

At this time, it was our custom to remove the roentgenogram from the mounting, place it in the envelop and file under the name of the patient. This was a definite step in advance, being more scientific and less complicated.

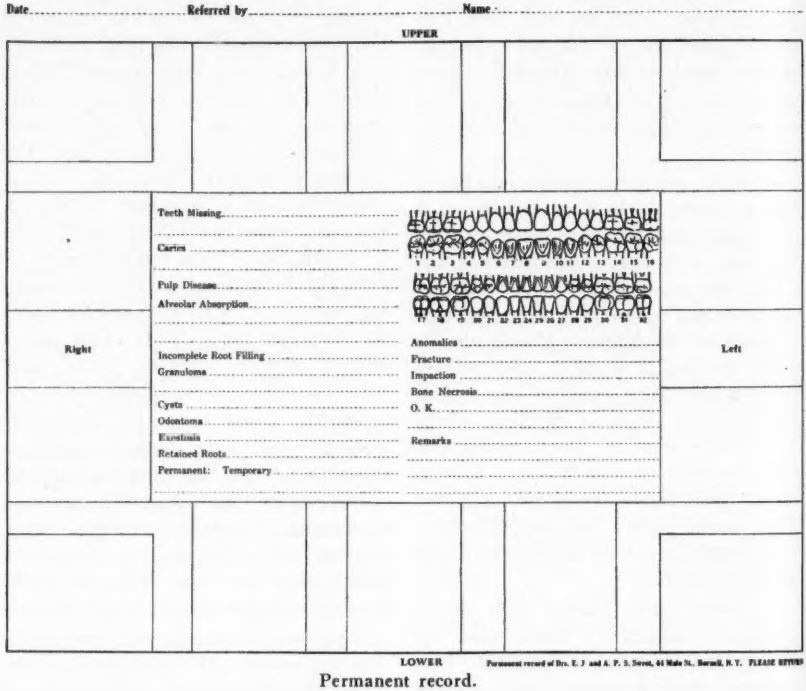
Shortly, a still better list of possible findings came to our notice[2]; and from this time on, the following list was employed: caries (dental); cysts; exostosis; granuloma; odontoma; retained roots; relation of temporary to permanent teeth; sinus infection; impacted teeth; bone necrosis; teeth out; teeth O. K.

Again a forward step had been made, but there was still room for improvement. The faults with the system as it stood at this time were, first, that there was too much wasted effort—the films were mounted, the case diagnosed and the diagnosis recorded, then the films were

1. Kent, E. N.: The Business Side of Dentistry, St. Louis: The C. V. Mosby Company, 1929, p. 126.

2. Dental Radiography and Photography, Eastman Kodak Company, Rochester, N. Y., Vol. II., No. 2, p. 10.

removed from the mounting and filed in the envelops. Secondly, the diagnostic procedure was still somewhat slipshod and sketchy. The third fault was that the envelops damaged the roentgenograms by allowing them to rub together. The first and third faults could have been remedied by filing the films in the mountings, but since the latter were of several different sizes and shapes, this procedure was unfeasible. Also, the mountings cost so much that soon there would be a considerable sum of money tied up in frozen assets. The second fault we recognized but did not seem to be able to remedy.



Permanent record.

In our plans for a better film mounting, we solved the filing problem by establishing the dimensions of 8½ by 10½ inches as the standard size for the mount. This size was decided on because it permitted the use of a standard letter filing cabinet and could be used in a typewriter. We also determined to have the diagnostic record card combined with the mount, thus doing away with the card and making the system much more simple. Wishing to have an expert opinion on such a projected film mounting, we made an appointment with R. S. Vorhees, Jr., of the Medical Division of the Eastman Kodak Company. Dr. Vorhees was kind enough to consider the idea of some merit and suggested that such a mounting could be printed by a local printer. At this time, during the course of a lecture by Dr. Vorhees, we discovered the way

to make the diagnostic technic very rigid and to reduce the chance of overlooking any condition to almost nothing. Dr. Vorhees advised making a systematic examination of (1) the enamel of every tooth; (2) the pulp of every tooth; (3) the gingival portion of every tooth; (4) the apex of every tooth, and (5) the bone surrounding each tooth. This certainly constituted a systematic, scientific procedure which, if carefully followed, should overlook nothing.

Our plans now being complete, the mountings were printed and a punch made with which to cut the windows. In this mounting, there are fourteen films. The diagnostic list of findings is conveniently located, together with a chart on which cavities may be recorded. This list is as follows: teeth missing; caries; pulp disease; alveolar absorption; incomplete root filling; granuloma; cysts; odontoma; exostosis; retained roots; permanent: temporary; anomalies; fracture; impaction; bone necrosis; O. K. A space is left for remarks.

The cardboard used in the mounts is heavy enough to hold the films securely, yet light enough to allow the mounting to be placed in the typewriter, even with the films in position. The cost also proved to be slight, about a cent and a half apiece for the printed mounting. The assistant cuts out the windows as they are needed.

This completes the story to date of our search for a more efficient method of diagnosing and filing roentgenograms. We hope that our ideas may be of some assistance to others.

SO-CALLED SCALLOPED APPEARANCE OF THE DENTINO-ENAMEL JUNCTION*

By A. W. RYWKIND, Moscow, U. S. S. R.

THE question of the structure or rather the configuration of the dentino-enamel junction has been studied during recent years by O. Walkhoff,[1] W. Meyer,[2] Balint Orban,[3] and Stanley D. Tylman.[4] Walkhoff, in his book, "Normal Histology of Human Teeth," discussed this question somewhat more fully than it is usually discussed in textbooks. I now have the opportunity to present my views, using as material not normal teeth but toothlike formations which were discovered during the study of an

*From the Pathologic-Anatomic Department (Director, A. W. Rywkind) of the Paul Dauge Institute of Stomatology and Odontology. (Director, J. A. Teplouchoff.)

1. Walkhoff, O.: Normale Histologie menschlicher Zaehne, Leipzig, 1924.

2. Meyer, W.: Strittige Fragen in der Histologie des Zahnschmelzes, Vierteljahrsschr. f. Zahnheilk., 1925, p. 3.

3. Orban, Balint: Zur Histologie des Schmelzes und der Schmelzdentingrenze, Vierteljahrsschr. f. Zahnheilk., 1926, p. 3; Dental Histology and Embryology, Philadelphia: P. Blackiston's Son and Co., Ed. 2, 1929, p. 45-48.

4. Tylman, S. D.: Dento-Enamel Junction, J. Dent. Res., December, 1928.

odontoma and described in my paper, "The Pathology of the Odontoma."[5]

Before going into detail, I wish to discuss briefly the opinions of the above mentioned authors. It is known that the dentino-enamel junction does not form a straight line but has a winding or "scalloped" appearance. (Fig. 1.) At the same time, the surface of the dentin represents a series of recesses or hollows, ing little in size. But there are also teeth in which these scallops are irregular in different places and sometimes even entirely absent, and then the junction between the enamel and dentin forms a more or less straight line. The scallops which are seen on the left side of Figure 1 correspond approximately to the configuration of the dentino-enamel junction which is found in the majority of cases.

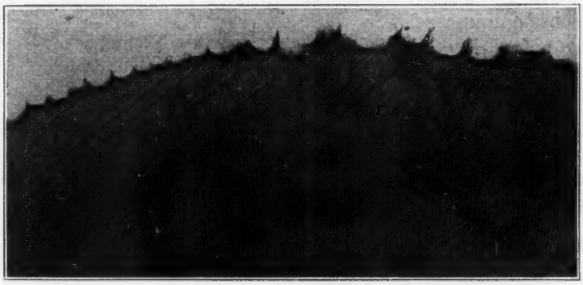


Fig. 1.—Scalloped configuration of the dentino-enamel junction.

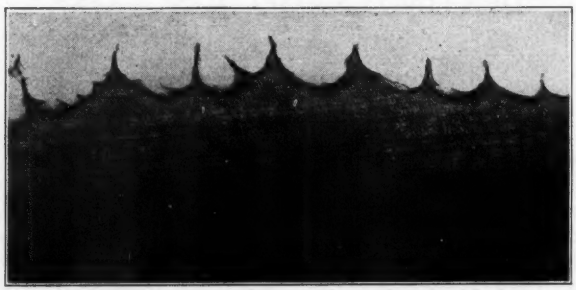


Fig. 2.—Dentino-enamel junction with scallops much larger than the average.

very similar, at first glance, to Howship's lacunae, which can be seen on the periphery of bone when it is resorbed by osteoclasts. The distribution of these recesses is sometimes very regular, varyFarther to the right, the incisions are considerably deeper.

In Figure 2, which was photographed with the same magnification, the recesses of the dentin surface are much larger than usual. In photographic pictures of decalcified teeth, these recesses naturally seem to be hollow, but, in ground sec-

5. Rywkind, A. W.: Zur Pathologie der Odontome, Vierteljahrsschr. f. Zahnheilk., 1929, p. 4.

Fig. 3.—Normal human tooth germ. *1*, epithelium lining the oral cavity; *2*, enamel organ; *3*, dental papilla.

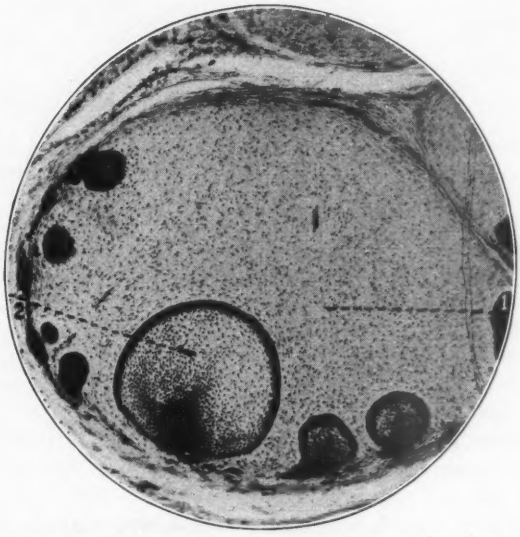


Fig. 4.—Section through the tissue of an odontoma. *1*, connective tissue corresponding in structure to the pulp of a tooth germ; *2*, enamel organ.

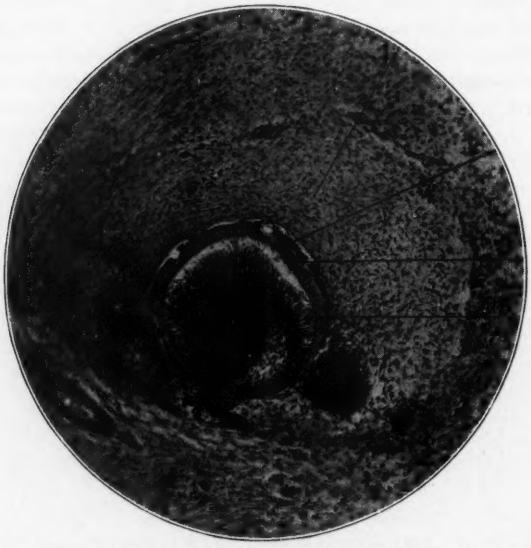


Fig. 5.—Section through the tissue of the odontoma shown in Figure 4, in a further stage of development. *1*, connective tissue corresponding in structure to the pulp of a tooth germ; *2*, layer of odontoblasts; *3*, dentin; *4*, enamel organ; *5*, enamel cells.

Fig. 6.—Section through the tissue of the odontoma, showing complicated configuration of the enamel organ. *1*, connective tissue corresponding in structure to the pulp of a tooth germ; *2*, enamel organ.

tions, one can clearly see that they are filled with enamel.

Walkhoff[1] explains this appearance of the dentino-enamel junction by the fact that when teeth are developing, the external layers of dentin are resorbed by the cells of the inner enamel epithelium. In order to prove this, he refers to his observation of the dentinal tubuli, which appear to be cut off at the junction with the enamel, and states that, on this basis, he concludes that the external layer of dentin, where dentinal tubuli divide into branches like little tassels, has been resorbed. Meyer[2] is of the same opinion. But, as Orban says, the photomicrographs of the scalloped external line of dentin which is printed in Walkhoff's book present evidence against the theory of resorption. In fact, in this picture, where the recesses of the dentin surface appear deeper than usual, the thinnest ramifications of the dentinal tubuli at the junction with the enamel are everywhere preserved. Evidently, therefore, the resorption of the external layers of dentin has not taken place here. Orban[6] likewise points out that a sudden break in the dentinal tubuli is far from the common occurrence which the writings of Walkhoff would indicate. On the contrary, the external layers of dentin are characterized by the finest ramifications of tubuli. In my material, I have never seen such a condition as that described by Walkhoff (except in pathologic cases; for instance, the resorption of the crown of an unerupted tooth).

Orban denies the possibility of resorption of the dentin by the cells of the inner enamel epithelium. He refers to the opinion of Erdheim and thus explains the origin of the scalloped appearance of the dentino-enamel junction: Before the formation of the hard substances begins, the cells of the inner enamel epithelium lie in contact with the odontoblasts. Usually, this line of contact is not straight but wavy, much like the later dentino-enamel junction. It is natural that later, when the formation of the first layers of dentin takes place, their surface retains the same scalloped appearance. On the basis of these findings, Orban comes to the conclusion that the theory that the scalloped structure of the dentino-enamel junction is a result of resorption of the

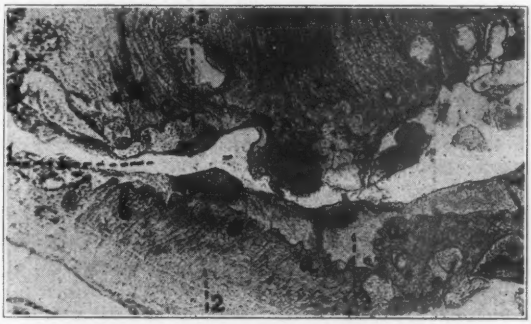


Fig. 7.—Ground section through the odontoma. *1*, fissure; *2*, dentin; *3*, enamel. At *a*, *b* and *c*, the dentino-enamel junction can be seen distinctly.

6. Footnote 3, first reference.

Fig. 8.—Ground section through the odontoma. *1*, fissure; *2*, dentin; *3*, enamel; *3a*, baylike indentations of enamel into the mass of dentin (the lower part of the picture [*2, 5, 4*] corresponds to a later stage of development of the area shown in Figure 5); *4*, area formerly occupied by the enamel organ; *5*, enamel.

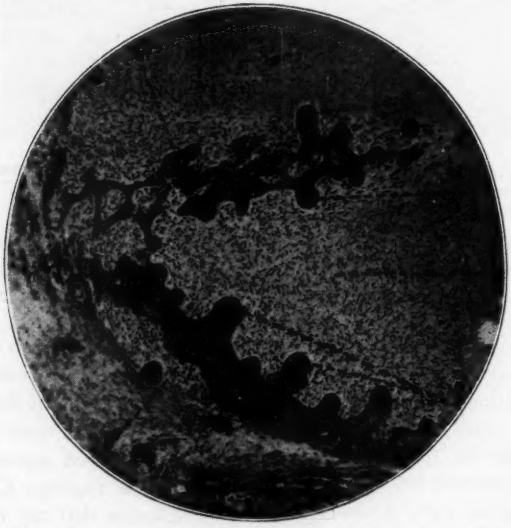


Fig. 9.—Section through the tissue of the odontoma. *1*, connective tissue corresponding in structure to the pulp of a tooth germ; *2*, epithelial strands corresponding to a dental lamina; *3*, budlike swelling of epithelium (undifferentiated enamel organs) in the connective tissue.

enamel cells is not so simple and self-explanatory as was heretofore supposed. This explanation of Orban was supported by a paper of Tylman,[5] who showed very plainly the normal branching of the dentinal tubuli at the borderline of the dentin, and, in contrast to it, dentinal tubuli that are cut off sharply without terminal branchings, by a pathologic process of resorption. The fact that there are terminal branchings beneath the scalloped surface of the dentin indicates that this configuration is not the result of resorption.

From the data which I have collected in the study of an odontoma, I shall first of all give the general characteristics of the tumor which I investigated. It was an exceptionally rare case in that it contained all phases of the development of an odontoma: from the embryonic stage, before the beginning of the formation of the hard substances, to the ripe phase, with the fully developed hard tissues. By comparing these different phases of development, one after another, one could easily trace the formation of such parts of a tumor, which by their construction correspond to the so-called hard odontomas, i. e., mature forms consisting of hard dental tissues.

We must remember that the majority of odontomas described before this time belong entirely to forms which, as products of an advanced development, permitted no conclusions about the process of their formation. The irregular distribution of enamel and dentin in tumors of this kind has always been of special interest to research workers. In these odontomas, layers of enamel and dentin are laid down without order or sequence, and sometimes areas of enamel are entirely surrounded by a mass of dentin.

From my material, it can be said that such an irregular position of the hard tissues in the mature portions of an odontoma is the result of the disturbed arrangement of the elements of the tooth germ. In the normal development of a tooth, the dental papilla—later, pulp—of a tooth germ protrudes into the enamel organ and is enveloped by it (Fig. 3), so that, in the process of a further differentiation, the enamel is deposited on the dentin; whereas, in the germs observed in the developing odontoma, a reverse condition exists, i. e., the enamel organs appear to be surrounded by connective tissue that corresponds to the pulp of a tooth germ (Fig. 4). It is natural that, in the further development of such formations, the dentin will be found covering the enamel (Fig. 5 and Fig. 8, *2, 4, 5)*, and, in some of the sections, the enamel appears to be surrounded by the mass of dentin. In some places, a very complicated arrangement of enamel organ and pulp was found. (Fig. 6.) If there were further development in the area of Figure 6 and a section was then made through it (for instance, if the section were made in the plane indicated by a line connecting the two crosses), the enamel and dentin would be found in alternate layers. Thus, the irregular position of hard tissues in odontomas—their alternate arrangement — resulting from the disturbed relations between the epithelial parts and the connective tissue during the embryonic formation disproves the theory of Retterer, who says that the dentin can be transformed into enamel.

These statements were made to facilitate the understanding of the following pictures. Figure 7 shows a deep fissure cut into the hard mass of the odontoma. This fissure is lined by a thin irregular layer of enamel. The scalloped appearance of the junction between the dentin and enamel can be seen very clearly. It

should be observed that the scallops, *a, b, c,* become consecutively larger. In *a,* their size corresponds approximately to that of a normal tooth; in *c,* they look like the deep recesses in Figure 2. Figure 8 is a photograph of another fissure. Here, the wavy configuration of the dentino-enamel junction shows a marked development, the enamel protruding into the dentin substance in baylike indentations. In the various sections through the hard mass of this odontoma, one can find all stages of development, from the usual scalloped appearance of the dentino-enamel junction to deep indentations. Figure 9 shows the process by which these indentations are formed. Here, we see epithelial strands lying in connective tissue having the structure of the pulp of a tooth germ. These strands correspond to a dental lamina and represent a series of budlike swelling, which are undifferentiated enamel organs protruding into the pulp tissue. If the soft tissue shown in this figure develops, forming hard tissues—dentin and enamel—the result will be as shown in Figure 8. Indeed, if we compare the fissure and its enamel swells protruding into the dentin of Figure 8 with the dental lamina and the undifferentiated enamel organs of Figure 9, the resemblance will be striking.

I believe that my findings concerning the arrangement of the hard tissues in the odontoma in its embryonic as well as mature state, together with the results of a comparison of Figures 8 and 9, may serve as a confirmation of the opinion of Orban concerning the origin of the scalloped configuration of the dentino-enamel junction. If one finds cases of gradual changes from the scallops of the usual type to the baylike indentation protruding into the mass of dentin (Fig. 7, *c,* and Fig. 8), and if the formation of such enamel buds is predetermined in the embryonic stage (Fig. 9), one can say that the normal scalloped appearance of the dentino-enamel junction is the result of the normal arrangement of the elements in a tooth germ in the earlier phases of its development. It can by no means be considered as the result of another process, such as the resorption of the dentin by the cells of the inner enamel epithelium.

TAINTED BREATH OR HALITOSIS

By THOMAS B. HARTZELL, M.D., D.M.D., Minneapolis, Minn.

BAD breath, commonly called halitosis, is the bane of the existence of many people. It is popularly supposed to be due to bad teeth, but is rarely ever, almost never, due to odors arising from the teeth themselves.

A simple test can readily be made by any one who is interested, by taking dry cotton held in forceps, or a clean kerchief, or a small napkin wrapped round one's finger, and rubbing the sides of the teeth of the individual whose breath is bad. The surface of the napkin or kerchief will rarely be found to afford any odor whatsoever, whereas, if the same effort is made on the brown or yellowish mass on the base of the tongue of the person whose breath is tainted, a whiff from the

stained napkin will at once prove the odor to be from the tongue.

The real source of common mouth odors is the surfaces of the tongue. The tongue is covered with papillae packed closely together. Each one is covered with epithelium. When we look at the tongue, we see the ends of these papillae. The multitude of crevices between the papillae afford lodging for many bacteria.

Under ordinary conditions of health, with the digestive apparatus working to perfection, there is not enough of these bacteria to destroy epithelium. If, on the contrary, digestion is faulty, the bacterial life of the tongue vastly increases in

Fig. 1.—Coated tongue.

Fig. 2.—Coated tongue.

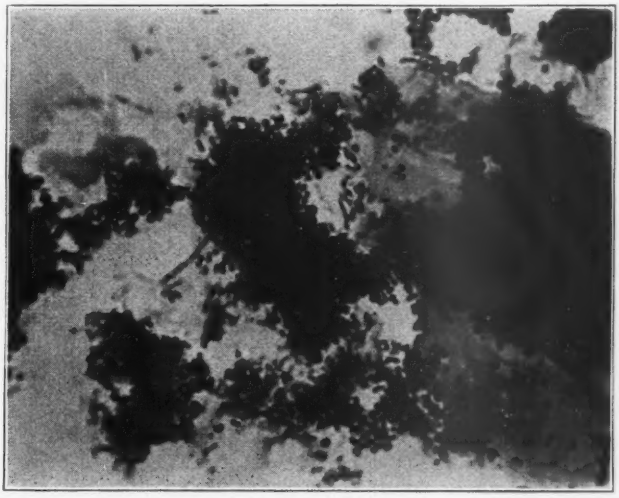


Fig. 3.—Tongue scrapings made up of masses of bacteria. There are a few dead epithelial cells, unstained, since these dead cells do not stain readily.

numbers, and, too, the desquamation of epithelium is delayed; so much so that the bacteria destroy the surface epithelium of the points of the papillae and in between them, and there will accumulate a coat on the tongue, yellowish brown in color and exceedingly offensive to the nostrils.

I herewith submit scrapings of a coated tongue, and also pictures of the tongue from which they came. One of the pictures (Fig. 3) was made to show bacteria only, because bacteria require a different character of stain to bring them into view, and a bacterial stain will not stain epithelial cells successfully.

As the bacterial ferments break down the epithelium and destroy it, gaseous odors, offensive to the nostrils, are set free in sufficient amount to make the breath offensive at even a distance of 2, 3 or 4 feet from the individual.

While it is true that material scraped from a large cavity in a tooth gives off some slight odor, it is rarely in an amount sufficient to taint the breath. On the contrary, scrapings from a coated tongue always taint the breath to some degree. The more putrefaction, the more marked the offensive odor.

There is one other source of tainted breath and that is putrefaction of the material in the nose. This condition, technically known as ozena, is in no way related to the mouth. It is far more difficult to deal with and can readily be distinguished from mouth odors by the simple test of smelling.

Maximow and Bloom, in their textbook on histology, page 480, say the long papillae on the tongue are from 2 to 3 mm. in length, and that the shorter, spongiform papillae are 0.7 to 1.8 mm. long. These papillae are packed closely together and the crevices lined with epithelium, and, as stated, they provide a lodging for bacterial growth. Maximow states that where digestion is interfered with, the desquamation of this epithelium is delayed and it accumulates on the papillary surfaces; and my observation is that as this epithelium is decomposed by bacterial action, it causes, with the bacteria themselves, coating of the tongue; and the decomposition of this epithelium, resulting in formation of gases, is responsible for the odor.

Lightly washing the tongue with cotton rolls or small gauze napkins wet in a suitable disinfectant or hydrogen peroxid, held in a kuroris or forceps, quickly deodorizes the putrefactive coat and also sweeps the dead material from the tongue.

THE IMPORTANCE OF CENTRIC RELATION AND HOW TO MAINTAIN IT*

By F. M. HIGHT, D.D.S., Houston, Texas

CENTRIC relation is the most retruded position of the mandible from which it can make comfortable lateral movements. It is best registered by recording the position of the mandibular incisor point. The position of this point in relation to the maxilla will vary with different vertical openings; but the record should be correct for each opening.

The location of the mandibular incisor point in rest position may not be at all the same as the location of that point in eccentric relation. It may be several millimeters forward of or to one side of its position in centric relation.

Centric relation is the only safe starting point for the construction of full dentures. It is a functional relation, probably obtained under strain, and it is of the utmost importance that the dentist should not confuse it with the rest position.

In the natural dentitions of those people who live under sufficiently uncivilized conditions that the dental arch maintains its finest forms and the dentition its maximum efficiency, there is practically perfect balance on the side opposite that on which the teeth are engaged in the final phase of food trituration. These people live largely on hard and fibrous food, which they masticate thoroughly.

The exertion of the considerable amount of force necessary for the final stage of trituration of hard and fibrous foods without injury to the temporomandibular mechanism is made possible only by a balancing contact of the teeth opposite the working side. This balance cannot be obtained with the rest position as the starting point, save in those rare cases in which the position of the incisor point in centric relation coincides with its position in rest.

In the minds of an increasing number of dentists, the apex of a well-traced gothic arch marks the location of the mandibular incisor point in centric relation.

In people who live under more civilized conditions, including diet containing largely soft foods, the ideal form of dental arch is often lost, and with it much of the masticating efficiency of the dentition.

This balance, which is essential to the greatest efficiency of the natural dentition, is even more noticeably essential to the maximum efficiency of artificial dentures, which are tissue borne, and which must be held in place partly by the forces to which they are subjected. This balance is achieved only by the accurate interaction of the cusp planes of the teeth, and this can be secured only by starting

* Read before the Section on Full Denture Prosthesis at the Seventy-Second Annual Session of the American Dental Association, Denver, Colo., July 23, 1930.

the construction of the dentures from the centric relation indicated for that case by the apex of the gothic arch tracing.

For those dentists who do not accept the gothic arch as registering central relation, it is necessary only to have some method by which to recognize for each patient the centric relation when it is obtained, or to know when it has not been found and how far and in which direction the case is out of centric relation.

Some dentists might be confused by the fact that with different degrees of opening of the mandible, the position of the gothic tracing on the registration table differs somewhat. This need not cause confusion, since the apex of each tracing will indicate the position of the mandibular and incisor point for that degree of opening.

I formerly thought that the vast numbers of artificial dentures not in centric relation indicated that dentists did not obtain the correct centric relation before beginning the construction of the denture; but more extended observation seems to show that many of the dentists who make these dentures may have obtained a correct centric relation at the chair and that it was lost through the technic employed by the laboratory.

However carefully this relation may be established at the chair, it is likely to be lost by any technic which vulcanizes both dentures at one time or which does not permit remounting the maxillary denture and the cast upon the articulator in their original position, after vulcanization, so that the mandibular teeth can be reoccluded to any changes in the positions of the maxillary teeth which have occurred.

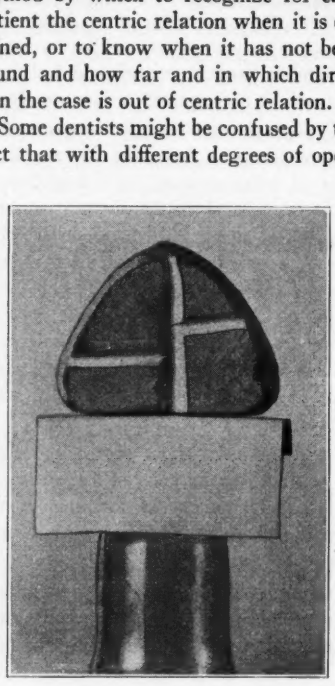


Fig. 1.—Upper surface of maxillary cast, grooved to permit remounting in its original position in the articulator.

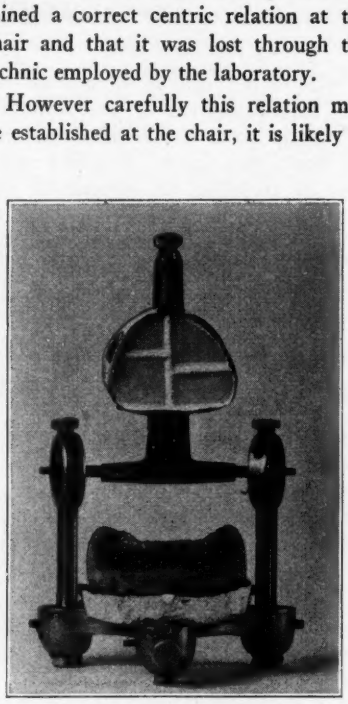


Fig. 2.—Plaster by which the grooved cast was attached to the model bow.

The changes referred to occur in the relations of the maxillary teeth to the maxillary cast. These changes of relation seem to be caused by changes in the relation in one part of the flask to the other part of the flask. They will be more apparent in cases in which the anterior portion of the maxillary ridge is prominent than in cases with flat ridges. They are more likely to occur if an excess of rubber is used in packing. As far as I know, such changes of relations of parts

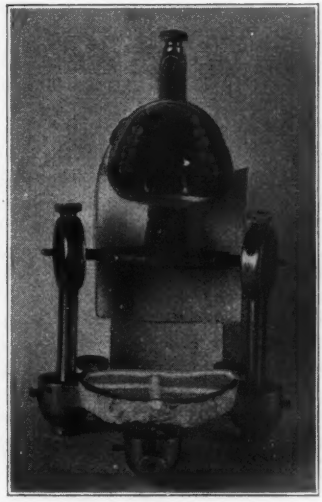


Fig. 3.—The maxillary cast remounted in the articulator, after vulcanization to permit such rearrangement of the mandibular teeth as may be required.

may occur in any flask now on the market. They are sure to occur if the parts of the flask fit together loosely.

Since it seems to be impossible to avoid such changes in many cases, it is desirable to employ a laboratory technic which makes it possible to correct the changes. This technic requires the use of some material for casts which will not be affected by vulcanization and the shaping of the cast in such way that it can be removed intact, with the denture, from the flask after vulcanization is complete and remounted on the articulator in its original position. This is made possible by grooving the top of the maxillary cast and the bottom of the mandibular cast before they are attached to the model bows. The grooved surfaces are moistened with soapy water and then attached to the model bows with plaster in the

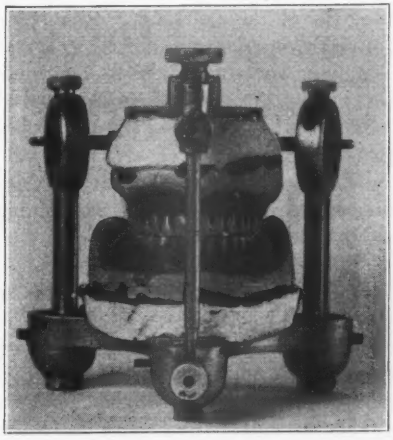


Fig. 4.—Plaster attachment for the mandibular denture after cast and denture have been removed for vulcanization.

usual way. Sticky wax is then run along the line of attachment between the cast and the plaster.

For vulcanization, the maxillary cast and denture are removed from the articulator, the grooved surface of the cast is again soaped and cast and denture are placed in the flask in the usual way. After vulcanization, the plaster around the cast is cut away, the cast and denture

are removed together and the cast is remounted in its original position in the articulator with the aid of sticky wax. The mandibular teeth, which are still in wax, are reoccluded to any changes of position by the maxillary teeth. It is rarely necessary to make any change in the position of the anterior teeth.

The mandibular denture is vulcanized and remounted in the same manner. Changes in relations of the mandibular teeth to the ridge are rare and such as do occur may generally be corrected by grinding, as part of the laboratory technic. Perhaps the reason that changes in position of the mandibular teeth occur so rarely, in relation to the ridge, is that the line of closure of the flask is more nearly through the teeth to the vertical axis of the ridge than with the maxillary teeth.

The four illustratious show the manner of grooving the casts and remounting in the articulator.

If the correct jaw relation was obtained and reproduced in the articulator before the teeth are set up and is again obtained and reproduced while the teeth are in wax and the casts and dentures are returned to their original positions in the articular, after vulcanization, as has been suggested, the teeth may be ground to this position in the articulator before the dentures are placed in the mouth.

DISCUSSION

J. C. Whitmer, Oregon, Mo.: I have used the gothic arch tracing for the last two years. About fifteen years ago, I made a gothic arch tracer, which I used in conjunction with wax bite rims. I gave it up because I did not believe it functioned well with wax bite rims. It may be of some value, but it is unreliable and inaccurate. In the two years that I have been using it, with the equalized bite technic that I am now employing, I have found the experience the same as that which Dr. Hall has had, in that the functional center does not seem to be in the gothic arch center. I believe that there are some cases in which the gothic arch is not the best centric relation on which to build a case. I think it may be best in a few cases, but they are the exceptions which prove the rule.

Dr. Hight (closing): The case that Dr. Hall cites is similar to five cases that I have had in my practice in the last twelve years. I use a gothic arch tracing on every upper and lower made in my office. His case proves that there is not a false joint in the fossea formed by this habitual chewing, because the patient made a definite gothic arch tracing, but could not function in the apex of that tracing. I think that you will find those cases when the last remaining teeth in the mouth are on the side to which the jaw moves.

CAVITY PREPARATION IN RELATION TO INLAY FIXED BRIDGE CONSTRUCTION*

By CHARLES H. GIETZEN, D.D.S., Omaha, Nebr.

FIXED bridge construction, an old subject to the dentist, is fraught with pitfalls and perils, not only to the patient but to the dentist as well; for though the patient may be the first to suffer through errors on the part of the dentist, the dentist may be assured that the old quotation, "Be sure your sins will find you out," will manifest itself, to his confusion and chagrin, if he has not seen the handwriting on the wall and has governed his activities accordingly. The day of the old fashioned gold crown, with its accompanying purple halo of hypertrofied, swollen and bleeding tissue, as a bridge abutment is passed in the practice of the modern fixed bridge worker.

If there was or is anything to commend bridgework of the past, it is its association with the word "fixed," for, as formerly constructed, fixed bridgework was so "fixed" that when anything came out, it was the bridge, still firmly fixed to the teeth which it abused and of which it was the final death knell.

So much of the past. What of the present and future?

That is a different story, but similar to that of the past in that it, too, has its perils and pitfalls, intensified, if you please, but with rewards and gratification to the patient and to the dentist as well, if the dentist has been alive to the trend of events and has kept abreast of the march of progress.

It is well at this point to emphasize the fact that the gold crown, properly constructed, is not *passé* in the building of modern fixed bridgework, but has its distinct and proper place.

Since Dr. Taggart gave us the first principles of the gold inlay, times have changed as regards fixed bridge construction, and, sad to say, much for the worse for those who have failed to realize the situation in relation to the word "fixed" in connection with bridgework. For inlay bridgework is a snare to those who have grasped only part of the truth in connection therewith. It behooves us, therefore, as masters in the art of fixed bridgework to take cognizance of what has been touched on in this summary, and have our ears to the ground in anticipation of what is before us.

That inlay fixed bridgework is the last word, so far, is not gainsaid by those who have been running and reading.

What is inlay fixed bridgework? It is the modern means of restoring lost members and lost function in the dental arch. It also regards the health of the surrounding tissues and esthetic requirements, so that restoring lost members and lost function need not mean unforgivable offense to appearance or cause further and more serious losses.

*Read before the Section on Partial Denture Prosthesis at the Seventy-Second Annual Session of the American Dental Association, Denver, Colo., July 24, 1930.

G. V. Black laid down the principle, which has become a law, "extension for prevention." In a consideration of cavity preparation in connection with inlay fixed bridgework, the first principle is extension for prevention. Technically, that is accomplished in the following manner: Suppose that we are making a bridge wherein the second bicuspid on either side of the upper arch has been lost. Suppose, also, that the first bicuspid and first molar are in first class condition as far as position in the arch and freedom from decay are concerned.

The first mechanical instrument will be the seven-eighth or five-eighth Jo-Dandy safe-sided carborundum disk mounted in either the straight or right-angle handpiece, according to convenience of approach. Giving the disk the inclination which will cut tooth structure from the molar and bicuspid so as to eliminate the "bell" and the contact point without cutting anything from the gingival border, but giving the cut described a decided occlusal angle, we obtain extension for prevention. Besides obtaining extension, we aid the placement of the two abutments in alinement with each other. Alinement is another principle which must be given consideration in planning and executing cavity preparation for bridgework; for if preparations are not in exact alinement, the bridge will not go to place.

This step completed, we mount a square-end crosscut fissure bur No. 558 in the contra-angle handpiece and proceed to box out the mesial and distal surfaces, respectively, of the teeth mentioned, sinking the bur to its full diameter depth, thereby making a flat gingival seat and carrying that cut occlusally across the axial wall to within about 1 mm. of the marginal outline of the cavity. The next step is to carry the cavity preparation across the occlusal surfaces of the two teeth, following the natural sulci to the distal pit with the same bur. A widening of the cut across the occlusal surface, which is now indicated, is accomplished by changing to a larger bur of the same description. The size of the last mentioned bur is indicated by the width of the tooth buccolingually, sufficient opening of the occlusal surface being made to harmonize the preparation from the standpoints of strength and balance in the subsequent casting and precaution against splitting of the tooth under mastication. This catastrophy is often prevented by placing the proper bevel on the marginal outline of the cavity on the occlusal surface, which is accomplished with a cylindrical stone mounted in the right-angle handpiece.

We now give our attention to the marginal outlines of the cavity, buccal and lingual. We find that because of the use of the No. 558 square-end crosscut fissure bur, we have left on the buccal and lingual margins a surface which is unsatisfactory for the finishing of marginal areas, because the bur has left a surface which is too sharp and has also neglected to take into consideration the inclination of the enamel rods at these surfaces (buccal and lingual margins). According to convenience and approach, we will now mount either the seven-eighth or one-half Jo-Dandy carborundum disk or the five-eighth medium garnet, Moore sandpaper disk and, with the instrument selected, cut a marginal bevel on the buccal and lingual walls, a bevel which will extend from the cut made by the square-end crosscut fissure bur to the buccal and lingual margins.

This procedure will make margins on these surfaces which will harmonize

nicely with the rest of the cavity preparation and will also be in harmonious alinement when it comes to the placement of the completed bridge. When the boxlike cut is made across the axial wall of the tooth, the cylindrically shaped groove made by the square-end crosscut fissure bur will appear occlusally at about the middle of the buccal and lingual cusps. In fact, this groove will often cut somewhat into the axial surfaces of these cusps. If this occurs, that portion of the cusp must be finished off with a wide enough bevel on the occlusal surface to cover the groove entirely in the finished casting. A full restoration of the form of the cusp in the wax pattern and the casting will accomplish the desired result.

On the occlusal surface and in the sulci, the bur should be sunk entirely through the enamel so that the floor of the cavity is composed of dentin alone. This does not mean that the wanton destruction of tooth substance is advocated or approved, but it does mean that, by going entirely through the enamel, we obtain a definite surface upon which the casting firmly rests. It also insures the carrying out of another principle in connection with cavity preparation for inlays, called frictional wall retention.

We may not safely depend on cementation alone to retain our castings in position. In fact, cementation should not in any sense be relied on for retention. The real purpose of the cement used in the placement of any casting is only to seal the inlay hermetically into the tooth. Therefore, by sinking the cut across the occlusal surface into the dentin, we make a definite step from the already prepared axial wall through the occlusal surface to the distal pit. On reaching the distal pit or sulcus, the bur is carried through the width of the distal sulcus from buccal to lingual aspect, or vice versa, thereby widening the occlusal cut at this point and forming a dovetail, which makes added frictional wall retention.

Not only do we follow out the full outline of the distal sulcus but, for additional retention, when making an attachment which is only mesioclusal or distoclusal, the small square-end crosscut fissure bur is sunk into the dentin from 1 to 2 mm. deeper across the distal sulcus than it has been sunk into the dentin of the rest of the occlusal surface. We have, by so doing, added materially to frictional wall retention in that we have an extension on the casting which lies parallel to that portion of the casting covering the axial wall. In my experience, this procedure makes a cavity preparation from which a properly fitted casting cannot be removed, after cementation, without destroying the inlay or breaking the tooth. Since we are making these attachments with the idea of their being permanently fixed, these are good points to remember and to know how to accomplish.

Going back to the cut made across the occlusal surface, which is, as before mentioned, through the enamel to the dentin, we find that we have established more frictional wall retention in that the axial walls of that portion of the cavity are parallel to each other on opposite sides of the cavity. Additional frictional wall retention is found in the grooves made at the buccal and lingual axial angles, where, being also parallel to each other, they oppose the displacement of the casting. Assuming, as we did in the beginning of this illustration, that the two teeth in which we have been making these preparations for bridge abutments are in their normal positions in the dental arch, we will now find, on studying them in their relation to each other, that we have established lines in the cavity preparations which harmonize with each other and

permit of the placement of both inlays in their respective positions when attached to the rest of the completed bridge; and this without undue torsion or strain on either tooth, which would surely occur if the lines in each cavity do not bear the proper relation to each other.

The purpose of this paper is the description of a simplified, standardized method of cavity preparation, using few but essential instruments in its accomplishments. I have in these pages given virtually the complete story. If we apply these principles to practically every bicuspid or molar tooth which calls for inlay bridge attachments, success is assured. There are exceptions, which will be enumerated.

By adding the three-quarter veneer preparations, which are used on cuspids and lateral and central incisors and the properly constructed full gold crown, these attachments will cover almost the entire scope of abutment preparation. There are other preparations which can be used in special cases on bicuspids and molars, such as the standardized three-quarter preparations for these teeth, but they are so seldom indicated that I shall mention them only in passing.

Returning to the mesioclusal and distoclusal preparations herein described: It is possible to convert these into three surface preparations, thus making them mesioclusodistal by the simple expedient of applying the same technic to the additional surfaces to be included.

Referring back to the exceptions mentioned, we must include teeth which are very short from the gum line to the occlusal surface, some malposed teeth, teeth which have tipped forward because of the lost support of missing teeth and those which have been seriously broken down through caries or which contain large fillings of various materials. For very short molars and bicuspids, the full gold crown is indicated. Some malposed teeth can be nicely handled with the standardized technic herein described, by accentuating the first cut made with the Jo-Dandy disk, enough more being removed from the occlusal surface and the mesial or distal convexity to put it in alinement with the other abutment, the operator keeping the inside cutting with the square-end crosscut fissure bur in alinement with similar cuts in the other abutment; this, of course, if it can be done without endangering the horn or other portions of the pulp. If the tooth is too malposed or tipped for this procedure, we again find refuge in the use of the full gold crown.

In bicuspids or molars, which already contain mesioclusal, distoclusal or mesioclusodistal cavities, with extensions into the lingual grooves, filled or unfilled, the foregoing technic may be used, fillings and deep-seated decay being removed and lost dentin surfaces built up with hard cement, the operator proceeding with the standardized technic, if enough supporting structure remains to make sufficient frictional wall retention. It becomes necessary, in many of these cases, to remove the occlusal surfaces to a sufficient depth to permit of shoeing the cusps, bringing the occlusal marginal outlines of the cavities up over the buccal and lingual cusps so that the opposing teeth strike entirely on gold in the act of mastication.

Word descriptions of technical procedures such as I have attempted in this paper must, of necessity, be rather long and tiresome and even then may fail to a certain extent in being sufficiently clear. Before closing, I wish to add a few remarks which, while not strictly pertaining to cavity preparation, are pertinent to success in the building of inlay fixed bridgework.

No dental restoration can be successful if intelligent attention has not been given to balanced occlusion. All inlay abutments should be thoroughly balanced with the other teeth in their existing occlusion before we proceed with the other details of bridge construction. This precaution naturally includes absolutely seating the abutment and finishing the margins. No overhangs should be left with the thought that they can be removed in the final finishing of the bridge. Failure to do this will surely result in the presence of cement lines about the margins, for no inlay is definitely seated in the cavity until all marginal excess is removed. After the bridge is finished and set, attention must again be given to occlusal balance, for the supplied teeth may have again disturbed that relation.

Several return sittings of the patient for further check-up of occlusion is essential, for the conscious movements of the mandible, such as are given when checking up with blue bite-paper, are different from those employed when the patient is actually masticating. Correct cementation of inlay bridgework is another important detail having to do with success or failure of otherwise good work. Nothing is more disconcerting to the dentist or annoying to the patient than having one or both attachments come loose because of failure to obey the laws governing cementation. More dangerous, indeed, is it if only one attachment comes loose, while the other remains firm, for it may be some time before the patient becomes aware of this condition and brings it to the attention of the dentist, who, after a bitter struggle to remove the still tightly sealed attachment without destroying the bridge, finds, to his dismay, that the tooth supporting the loose attachment has melted down like snow under the summer sun, because of the quick ravages of decay caused by food carrying saliva, which has seeped in.

Ruthless and needless cutting of sound tooth structure is criminal. On the other hand, sufficient shaping of the tooth or cavity to insure permanency of the work may well be considered in the light of conservatism. Timidity in the initial preparation may be the height of folly, in that poor preparation of abutments must eventually result in further destruction through decay, with ultimate loss of the tooth. Let us not then be cowardly in the performance of our duty. Hew to the line fearlessly, but with intelligent regard for the continued life and usefulness of the tooth. To do less than are the requirements is more reprehensible than what might seem to some as radicalism. In my teaching of students at Creighton University, I find that the principles as herein enumerated are quickly grasped and easily retained.

While inlay fixed bridgework may be fraught with many perils, by using intelligence and the scientific instruction and experience passed on to us by those who have pioneered in this admirable method of replacing lost members and restoring the function of the dental arch, and with the excellent results which are obtained through the use of the baked porcelain saddles associated with it, this work becomes a joy, and of inestimable benefit to both patient and dentist.

I have purposely left out any detailed description of the three-quarter veneer preparation used on the six front teeth above or below, realizing that those using inlay fixed bridgework probably first learned the principles of its construction, for it was really the beginning of all that has followed in inlay bridge building.

For what knowledge and skill I have attained in mastering the three-quarter preparation and its companions in beauty

and service, the baked porcelain saddle pontics and other inlay preparations, I make acknowledgment to Drs. Tinker, H. A., and T. W. Maves and Benjamin Sandy, all of whom are pioneers in this work and with whom I was in close contact when inlay fixed bridgework was in its infancy.

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DISCUSSION

Benjamin Sandy, Minneapolis, Minn.: In the bridge problem outlined, Dr. Gietzen would undoubtedly use the broken stress principle. In that case, since the major torsional pressure would be on the posterior abutment, if we assume the solder joint to be at that point, the anatomic limitations of both bicuspid and molar could be adhered to. The shallower cavity would be used in the bicuspid, and the molar, with its greater bulk, easily permitting a bolder preparation, would carry the greater load. Those who have had occasion to remove inlays with pin anchorage appreciate the strength gained in this manner, and, undoubtedly, this type of retention, principal or auxiliary, will solve the problem of stresses in many cases of short teeth and those in which considerable pulp recession has occurred. The usual depth is from 2 to 3 mm., and about 20-gage iridioplatinum is used. Sometimes, the anatomic form will permit a larger pin, in which case it may be simply a part of the casting. When there is a carious tendency in the mouth, the mesioclusodistal type should be used instead of the mesioclusal or distoclusal. In biscupids, the display of gold frequently prevents the use of the disk in making the initial cut. In this case, we undermine the mesial enamel with a fine crosscut fissure bur to the approximate depth of the gingival seat, then fracture the enamel segment from within out with chisel, and block the cavity to points of immunity. The attitude of the laity and of medical men toward the gold crown, which followed the appreciation of the importance of oral sepsis, has done much to eliminate this splendid form of abutment. We are all frequent witnesses of the ravages of caries under loosened inlay attachments on short or otherwise contraindicated abutments, where the modern cast crown would have saved the day. In reference to the remark that inlay fixed bridgework is the last word, I am reminded of the statement of W. D. N. Moore: "The removable bridge begins where the fixed bridge ends. . . . In other words, if the strain to be exerted on the fixed bridge would, by conservative estimate, be greater than the resistance to be expected of the supporting tooth or teeth and their normality be maintained, the removable bridge as a field of usefulness meets certain conditions and requirements most admirably."

Dr. Gietzen (closing): If you could see the operations prepared, and with the instruments that I have described to you, you would have presented to you a proposition which is simple and a procedure that is easily accomplished and very satisfactory. I use the broken stress bridge very little. I used to use it, but have practically quit doing so. I now use what I term a real fixed bridge, with the attachments fastened together. I have found that the broken stress bridge often results in displacements of either one or the other of the attachments. This may be due to the occlusal stress.

A COMPARISON OF SOME OF THE METHODS OF TAKING IMPRESSIONS FOR FULL DENTURES*

By EARLE S. SMITH, D.D.S., Iowa City, Iowa

THE purpose of this paper is to review and call to mind the fundamental objectives which should be sought in taking impressions for full dentures, and, with these objectives in mind, to analyze and compare a number of the prevailing methods of taking impressions attempting to point out how the objectives are attained by the various methods.

Widely varying methods of taking impressions for full dentures are being followed by operators at the present time. Years ago, with plaster and waxes as the available materials, the methods were limited, but with the introduction of compounds and, more recently, the colloidal, gelatinous materials, the possibility of numerous combinations of these materials has aroused the ingenuity of men in devising new methods until, at the present time, there is a large assortment from which to choose.

Three objectives quite commonly accepted as desirable in an impression are that it should (1) cover as large an area as is possible under the conditions presented; (2) have definite peripheral limits; (3) insure accurate adaptation to the tissues being covered. One other objective which has often been mentioned but about which there is considerable disagreement relates to the equalization of pressure.

The force of atmospheric pressure on a surface varies directly as the area of the surface varies. This is also true of adhesion. Practically all are agreed that, to obtain the utmost assistance from these two agents of Nature, dentures should cover as large an area as the conditions will permit. The size of the surface that can be utilized for dentures varies from person to person; but in any one mouth, the area covered should be as large as the mouth will permit, the periphery of the denture falling just short of interference with muscle and tissue movements during function.

For the upper impression, the periphery on the labial and buccal aspect should be at the top of the vestibule of the mouth. Behind the tuberosities, it should be over the groove which is just in front of the hamular process. Over the vault, it should rest on the immovable portion of the soft palate. (Figs. 1 and 2.)

For the lower impression, the peripheral limits on the labial and buccal aspect should be at the bottom of the vestibule. This margin at its posterior extremity should curve lingually and slightly backward to include, as it passes over to join the lingual margin, all, or nearly all, of the retromolar area and, on the lingual aspect of the ascending ramus, to include what is known as the retro-alveolar area. The limit to which the impression can be extended posteriorly on the lingual surface of the ascending ramus will be deter-

*Read before the Section on Full Denture Prosthesis at the Seventy-Second Annual Session of the American Dental Association, Denver, Colo., July 23, 1930.

mined by the flexible curtain of soft tissue covering the musculature in this vicinity.

The placement of the margin of the lingual flange of the lower denture is dependent on the position of the muscles and tissues making up the floor of the mouth when influenced by the functional movements of the tongue. At the median line, the margin should lie just above the lingual frenum when the tongue is in a raised position. From here, the margin passes laterally and, after passing the cuspid region, should dip downward to reach its lowest point, generally in the region of the second bicuspid. At this point, the margin should pass slightly upward as well as backward to follow along the

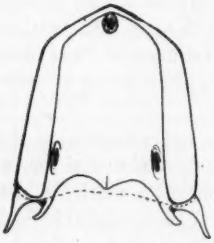

Fig. 1.—Relationship of hamular process to alveolar ridge (posterior limit for upper denture indicated by dotted line).

mylohyoid ridge to the point where the ridge fades out. The margin should then curve slightly downward, backward and then upward to join the posterior margin. (Figs. 3 and 4.)

With slight variations, these are the limits generally recognized as desirable for impressions for completely edentulous cases.

Adhesion is the molecular attraction exerted between the surfaces of bodies in contact. As applied to prosthesis, the better the adhesion, the better the retention. The degree of adhesion that can be gained between an impression and the tissues it covers will depend largely on the accuracy of the adaptation of the impression material to the tissues. But tissue conditions vary in different mouths. Even in the same mouth, tissues in certain areas will be much more compressible than in other areas. Hence, one of the principal problems presented in taking impressions concerns adaptation to tissues which vary in texture and in compressibility, and involves the question as to how much or how little the tissue should be compressed.

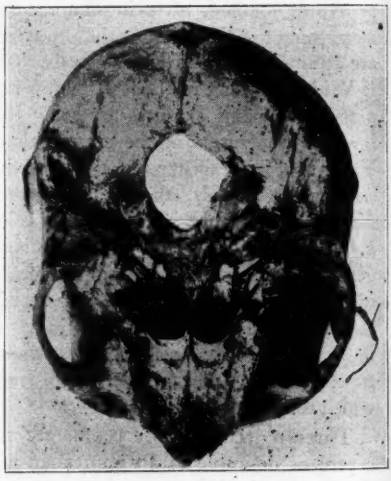

Fig. 2.—Base of skull; showing position of hamular process.

The problem of compression of tissues has given rise to two opinions. Some men take the view that the soft tissues, to be able to resist stress efficiently, should be compressed to the extent that they will oppose stress as well as do the hard tissues, and that the impression should represent the contour of the tissues that exists during function. Other men take the stand that the tissues should be compressed only to the minimum degree and

that the impression should represent a contour of the tissues undisturbed by functional stress.

Opposition to the first procedure is based on the fact that constant overcompression of the tissues by a denture cannot be maintained without interfering with the normal tonicity of the tissues.

To compress an object, it is necessary that the constituent parts of the object be brought closer together. If one of the constituent parts is a fluid, the fluid is likely to be driven out. This is really what occurs in tissues being compressed by a denture: the blood is forced into the deeper tissues by the compression. This interference with the blood supply, if maintained, will cause functional disturbance and adverse results. C. J. Stansbery[1] defines normal tissue balance as implying a certain proportion of cellular tissue to vascular tissue. He also states, "Compression causes a diminution of vascular content and, the contents of the veins and arteries having been expelled, the normal tissue balance is disturbed." This is one of the causes of resorption.

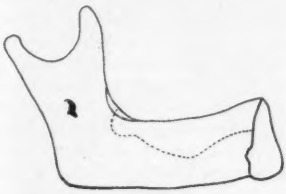

Fig. 3.—Lingual aspect of half of mandible. The dotted line indicates the limit for a lingual flange for a lower denture. The low point of the flange is in the region of the second bicuspid.

Another point as regards overcompression is that the blood having been driven out, will, if the pressure is partially released, attempt to work its way back through the vessels from which it has been excluded, and it is plausible to believe that, in some cases at least, it will be able to do so to the extent that the contour of the tissues will be altered sufficiently to cause a loss in retention. Denture patients having much soft tissue in the vault of the mouth and over the alveolar ridges often experience loss of retention if much force was used in the taking of the impressions. Such dentures will exhibit excellent retention under stress, but when the stress is released and the tissues are relaxed, dropping of the denture occurs owing to a change in contour of the tissues by the re-entrance of the blood.

Fig. 4.—Lingual aspect of mandible cut in half; showing mylohyoid ridge. (Compare with Figure 3.)

Those opposed to heavy compression also point out that, as dentures are used for masticating purposes for a small part of the time only, and as the tissues for the major part of each twenty-four hours are not under stress, the denture should fit the tissues when having the contour that will be maintained during the greater part of the time. In other words, according to these men, adaptation brought about by slight compression of the tissues should be the goal sought.

1. Stansbery, C. J., Pacific Dent. Gaz., 36:73 (Feb.) 1928.

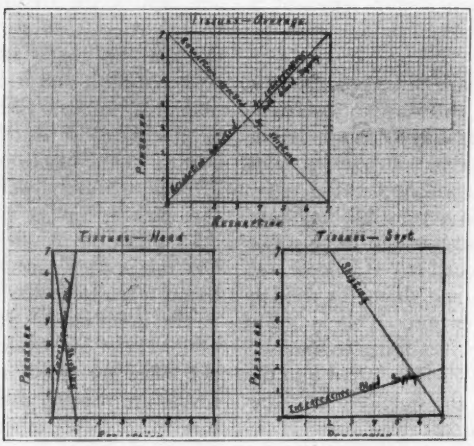

Fig. 5.—Right: Tissues soft as regards compressibility. Zero pressure in taking impression results in: (1) no interference with blood supply; no resorption; (2) a marked degree of shifting, resulting, in turn, in marked resorption. Seven units of pressure in taking impression result in: (1) insufficient pressure to completely minimize shifting (some resorption occurring on account of shifting even with this pressure); (2) marked interference with blood supply, assuming that even two units of pressure are sufficient to cause seven units of resorption. The conclusion is that (1) intersecting lines diverge very rapidly in a horizontal direction, indicating that variations in pressure affect resorption markedly; (2) the operator is limited as regards the amount of pressure, light pressure being indicated for this type of case, and even this is not ideal; (3) compound is contraindicated and plaster or some similar material the manipulation of which does not require heavy pressure is to be preferred. Left: Tissues hard as regards compressibility. Zero pressure in taking impression results in: (1) no interference with blood supply; no resorption; (2) some resorption on account of some shifting, but slight shifting in comparison with that of other types of tissues. Seven units pressure in taking impression results in: (1) some resorption on account of interference with the blood supply, but interference is slight in comparison with other types of tissues; (2) no shifting; no resorption. The conclusion is that (1) intersecting lines diverge very slowly in a horizontal direction, which indicates that a variation in pressure affects resorption very gradually; (2) the operator has considerable leeway as regards the amount of pressure and can, with a reasonable degree of safety, use either heavy or light pressure, being governed by the kind of material that he wishes to use—heavy pressure for compound and light pressure for plaster. Above: Tissues normal as regards compressibility. Zero pressure in taking impression results in: (1) no interference with the blood supply, hence no resorption as far as this factor is concerned; (2) a maximum amount of shifting and hence of resorption as far as this factor is concerned. Seven units pressure in taking impression results in: (1) maximum interference with the blood supply, hence maximum resorption as far as this factor is concerned; (2) a minimum amount of shifting and hence of resorption as far as this factor is concerned. The conclusion is that the intersection of lines indicates a medium degree of pressure as desirable for this type of case.

The opponents of this procedure argue that light compression will permit a denture to shift and that shifting of a denture will cause overstimulation and resorption. In reality, resorption may be caused by extreme methods in either direction—overcompression and interference with the blood supply, on the one hand, or light

compression resulting in shifting and overstimulation on the other. To show the relationship that these factors, resorption caused by interference with the blood supply and resorption caused by overstimulation, have to compression, and to attempt to determine theoretically the amount of the compression that is desirable for a given set of conditions, numerical values may be assigned and plotted and crude curves developed.

Of the various methods of taking impressions for full dentures, the use of the plaster in a stock metal tray is one of the oldest. In using plaster in

Fig. 6.—Plaster impression in stock metal tray.

a mass, because of the size of the tray and the character of the soft plaster, its flow is uncontrolled and uninterrupted, and it is practically impossible for the operator to cause the flow of the plaster to stop at certain limits and to prevent it from going farther. Overextension and underextension of the limits desired are the results. (Fig. 6.)

This is not true when plaster is used in small quantities and when controlled by a well adapted tray, the limits of which have been trimmed to the points desired. Individual trays can be made by swaging metal, by vulcanizing rubber or by adapting shellac baseplate materials over a plaster cast made from a "snap" impression of the case. Individual trays can also be made of compound, either by adapting the compound to a trial cast or by adapting it directly in the mouth. (Fig. 7.)

The use of the individual tray is to be commended. The advantages gained by its use are that the amount of impression material is minimized, the flow of the impression material is more or less controlled, warpage of the impression is prevented and definite peripheral limits are more easily attainable.

For establishing the peripheral limits of a compound impression, two methods are in vogue: The edges may be trimmed arbitrarily with a knife, the amount of trimming necessary being determined by an examination of the mouth (Fig. 8*C*), or it may be based on measurements taken in the mouth with calipers, the calibrations being then transferred to the impression. The edges may also be trimmed by functional movements of the lips, cheeks and tongue, brought to bear on the edges after the latter have been heated to a soft, moldable consistency. The latter method has been given the name "muscle trimming." (Fig. 8*B*.)

Muscle trimming has several disadvantages: If the flange of compound is not heated sufficiently, the action of the muscles may not be strong enough to trim it; if it is overheated, warpage and distortion may easily take place; if it is heated unevenly, an uneven adaptation to the tissues will take place. While muscle trimming can be followed for both upper and lower impressions, it can be used more easily on an upper than on a lower, and for the average workman, knife-trimming of the lower is probably the safer and the preferable method. (Fig. 9.)

When a "wash" of some material such as plaster or some of the plastic materials which lately have appeared on the market is to be used in combination with a tray, the flanges of the tray are trimmed just short of interference with the muscle and tissue attachments, and the edge of the impression is formed by the plastic material. The plastic wash being of even consistency and easily moldable, light, accurate adaptation to the flange tissues without undue extension is possible.

pression. C. J. Stansbery[1] states: "Modeling compound, subjected to pressure between two rigid surfaces, with escapement only around the margins, the area of greatest pressure against these surfaces will be that portion farthest from its escapement." In other words, when a mass of plastic compound in a tray is applied to the roof of the mouth, the pressure being applied over the center of the tray, the best adaptation of the compound to the tissues will be directly beneath the area

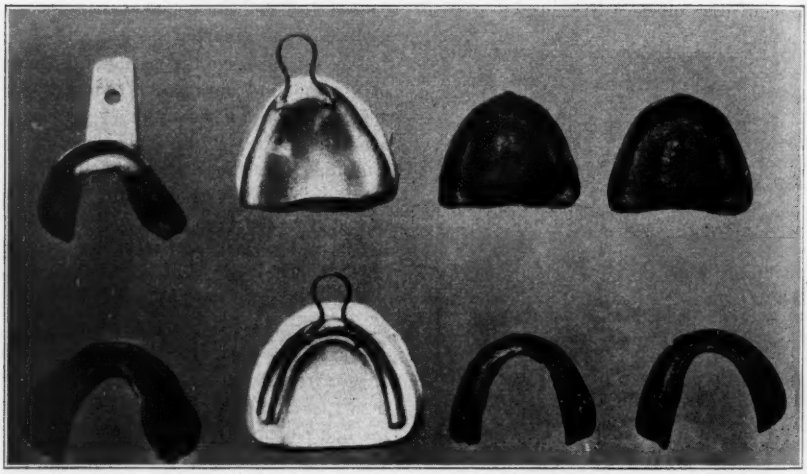

Fig. 7.—Various types of impression trays; stock trays made of soft metal and tin; individual trays made of compound, baseplate and vulcanite.

The technic to be followed to secure adaptation to, and compression of, the tissues, is dependent on the nature of the material used and the character of the tissue to be covered by the impression. Compound, owing to its viscosity, is much slower to adapt itself to a surface than is plaster. The uniformity of its adaptation is dependent on the degree of fluidity of the compound and on the point of application of pressure in seating the impression. where the pressure is applied and the poorest will be near the periphery. Indications of lack of adaptation can often be noted near the posterior part of the vault portion of an upper impression by the striations in the compound. (Fig. 10*A*.)

Lack of adaptation is correctible in several different ways. If the amount of correction necessary is slight, resoftening of the surface of the compound over the ridge and vault portion and reseating of

the impression are often sufficient. In doing this, the surface compound, being softer and more nearly in a fluid state and being surrounded by a hard outer shell of compound, can be forced into closer apposition with the tissues than was possible when the "snap" impression was taken.

Another method of correcting lack of adaptation in the vault portion involves tracing the compound over the faulty area. With a spatula, the added compound is brought to a feather edge as it nears the well-adapted area. (Fig. 10*B*.) The surface of the new compound is resoftened to a slight depth, the impression is carried to the mouth and, guided by the hard, well-adapted portion, is seated in the original position held by the impression.

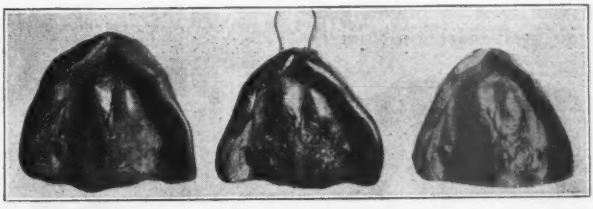

Fig. 8.—Methods of trimming. Left: Snap impression of an upper arch. The tissues have been overextended. Center: Peripheral border formed by muscle trimming. Right: Peripheral border formed by knife trimming.

Fig. 9.—Method of trimming a lower impression. Right: Snap impression. The tissues have been overextended. Left: Peripheral border formed by knife trimming.

Fig. 10.—Correction of adaptation by adding compound. Left: Snap impression. Striations in the compound in the posterior part of the vault indicate lack of adaptation in this area. Center and right: Lack of adaptation in vault and flange areas corrected by addition of compound.

Whenever a correction of adaptation is being made by adding compound, whether it is for the vault portion or for the flange portion, it is essential that the original position be held each time, and, while this position is being maintained, to bring about the correction in the areas needing it. Displacement from the original position held by the well-adapted part merely means the entrance of new errors. (Fig. 11.)

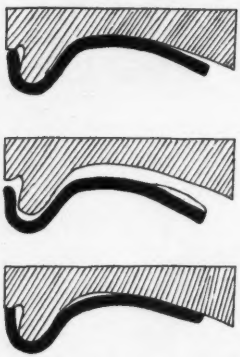

Fig. 11.—Above: Anteroposterior cross-section of upper snap impression. Adaptation is defective in the posterior part of the vault. Center: Addition of compound for correction. Below: New error in center of vault, produced by improperly seating impression in mouth.

For correcting the adaptation of a flange portion of a compound impression, one of two methods is generally followed. Softening of the flange to the bending stage, reseating of the impression, and, while holding it securely in place, the bending of the flange into contact with the tissues either by pressure on the outside of the cheeks and lips or by direct pressure, is one method. The correction may also be accomplished by adding compound to the inner surface of the flange

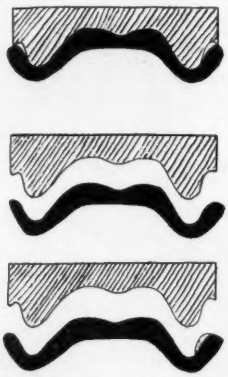

Fig. 12.—Above: Buccolingual cross-section of upper snap impression. Adaptation is defective near the edge of the flange. If correction is to be made by bending, the flange should be trimmed thinner, as the one in the center on the left, than if the correction is to be made by the addition of compound, as the one on the right (center). Below: Compound added preparatory to placement in mouth for correction of lack of adaptation.

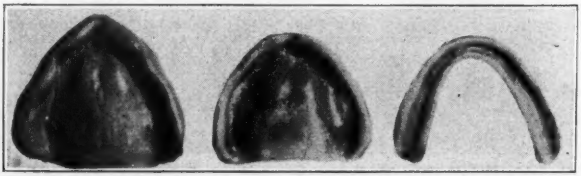

Fig. 13.—Left: Snap impression for upper denture. Center: Impression after being trimmed and adaptation of vault and flange portion corrected by paraffin wax. Right: Lower impression after being trimmed and adaptation corrected by paraffin wax.

near its periphery. The compound is shaped to a feather edge as it approaches the ridge portion, the newly added compound is resoftened and the impression is seated. The softened compound is thus forced into tight contact with the tissues by the hard, rigid outer portion of the flange. If a flange is to be bent, it is essential that it be trimmed thin enough to permit bringing it to the bending stage without an undue amount of heating being necessary. If the second method is to be followed, the flange should be thick enough to maintain its rigidity when the

Fig. 14.—Above: Buccolingual cross-section of upper impression showing errors introduced if impression is not securely held when adaptation of flange portion is being corrected. Center: Corrected impression. Below: Series of cross-sections of lower impressions showing (1) error in adaptation of labial flange; (2) compound added; (3) error in adaptation of lingual flange due to pressure applied in wrong direction; (4) correct adaptation.

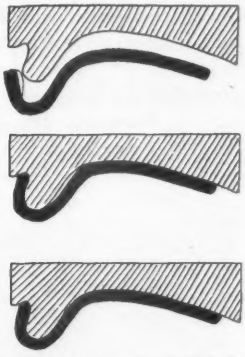

Fig. 15.—Above: Compound added for correction of flange adaptation. Center: Flange error corrected; new error occurring in center of vault, due to upward and backward pressure having been applied. Below: Correct adaptation.

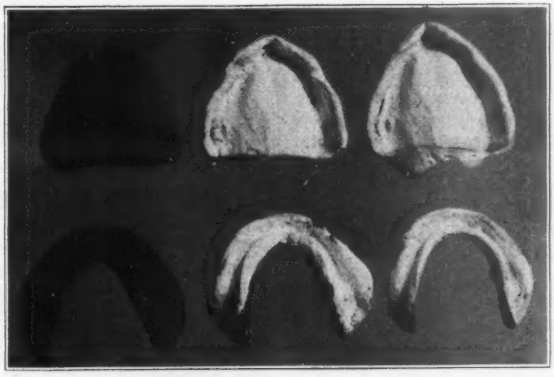

Fig. 16.—Impressions made by using compound trays together with a wash of plaster or some other plastic material.

new material is added and the impression is seated. (Fig. 12.)

Some operators prefer to use a soft paraffin wax instead of compound, for perfecting the adaptation of the flange portion of an impression. (Fig. 13.) The use of wax instead of compound has the advantage that danger of overcompression, unequal compression and displacement of the primary part of the impression is minimized.

If a correction for the whole length of a flange is necessary, the bending method or the adding of wax is to be preferred to the use of compound, as

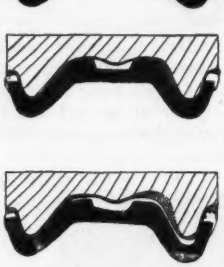

Fig. 17.—Above: Cross-section of upper impression; reliefs cut in center of vault previous to the application of plaster wash. Center: Properly seated impression carrying a plaster wash. Below: Improperly seated impression carrying plaster wash showing overcompression of tissues on one side and undercompression of tissues on the other.

there will be less danger of overcompressing the tissues and less danger of displacing the part of the impression which has already been corrected. If the correction of only a small area is needed, the adding of compound is very useful.

Whatever method is followed, a careful seating of the impression and the holding of it securely in place are a prerequisite if accuracy is to be attained. (Fig. 14.) The anteroposterior shifting often noted in an upper denture, as evidenced by firm retention when the denture is shifted posteriorly and the labial flange is brought into tight contact with the tissues, and by weak retention when the denture is shifted anteriorly and the labial flange is

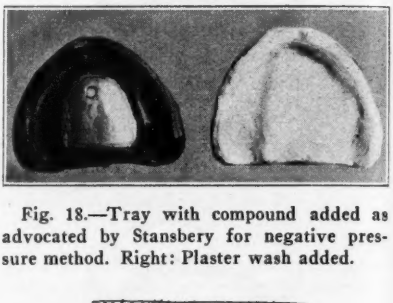

Fig. 18.—Tray with compound added as advocated by Stansbery for negative pressure method. Right: Plaster wash added.

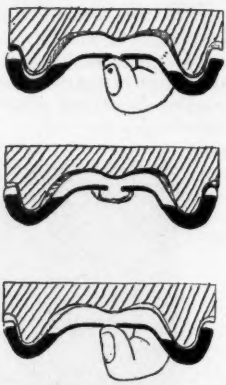

Fig. 19. — Stansbery negative pressure method. Above: Tray carrying plaster wash seated part way to place. Center: Perforation in center of tray uncovered and heavy pressure applied. Below: Perforation in center of tray again covered by finger and pressure released.

brought out of contact with the tissues, is, in many cases, due to a faulty seating and holding of the impression while the adap-

tation of the flange portion was being corrected. (Fig. 15.)

A semi-equalization of pressure is attempted in one method by cutting reliefs in the part of the compound tray which comes in contact with the hard areas in the mouth, following this with the application of a wash of plaster, or some similar material, which will flow easily and readily without causing distortion or compression. (Fig. 16.) When the impression is seated and pressure is applied, the relieved area in the tray will permit the compression of the softer tissues by the compound, and while these tissues are being held under stress, an imprint of the contour and fine detail of all of the tissues will be accomplished by the wash. (Fig. 17.)

A variation of this procedure is the negative pressure method of Dr. Stansbery. A metal tray, trimmed and fitted to a plaster cast of the case, is lined with compound over the ridge, flange and postdam areas. Trimming of the compound for peripheral limits and for adaptation is first accomplished. A hole, one-eighth inch in diameter, is cut through the metal tray near the center of the vault and a plaster wash is applied. (Fig. 18.) In carrying the tray to place, the perforation is covered, and it is kept covered until the impression has been seated. The perforation is then uncovered, heavy pressure is brought to bear and the excess plaster oozes through the perforation. The perforation is again covered and the pressure is released. (Fig. 19.)

In explaining this method, Dr. Stansbery states,[1]

> Plaster—if its main characteristic has been fluidity—within the palatal chamber, in obedience to the laws of hydraulics, has gone through three stages of pressure transmitted in all directions: (1) A pressure equal on tissue and tray while the perforation is closed. (2) No pressure on tissue or tray while the perforation is open. (3) Negative pressure on tissue and tray while the perforation is closed and under the debounding force of the tray's elasticity.

It would also seem that at least a part of the debounding force may be produced by the tissues.

Another variation in method to gain semi-equalization of pressure is described

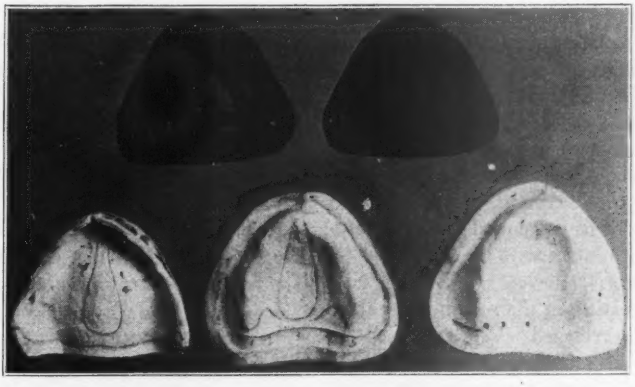

Fig. 20.—Series of views to show progressive steps in gaining semi-equalization of pressure by Neil method; compression of tissue of postdam area attained by scraping cast.

by Ewell Neil. A compound impression is taken, flanges are trimmed and adaptation is perfected. Liberal reliefs are cut into the compound tray not only for the hard central area of the vault but for the postdam area as well. In seating the compound tray carrying the plaster wash, a minimum amount of pressure is applied. After the impression has been taken, relief for the hard area in the center of the vault is arbitrarily scraped in the plaster finish, the depth of the scraping being based on the prominence of the hard tissues and on the compressibility of the tissues over the alveolar ridges. Compression of the tissues of the postdam area is brought about not only by the impression but by arbitrary scraping of the cast, the depth of the scraping being determined by examination and testing of the compressibility of the tissues in the patient's mouth. (Fig. 20.)

When, instead of two materials, compound alone is used for taking an impression, a variation in procedure must be employed. The compound tray, where it comes into contact with the hard areas in the mouth, is relieved by scraping, and before reseating in the mouth, the entire surface is reglazed. When carried to place in the mouth, the compound will first come in contact with the soft tissues and will begin to flow, and by the time the compound in the areas which were relieved comes into contact with the hard tissues, the compound over the soft tissues will have become somewhat condensed and more resistant and its presence will bring about a compression of the soft tissues at the time the impression of the hard tissues is being formed.

For one who understands its whims and its habits, compound will prove a valuable servant; for one who does not, it is apt to prove a treacherous ally. In the application of heat for reglazing or for applying a postdam, certain areas unwittingly may be made more plastic than others and there easily may be an unevenness of compression and adaptation. Unevenness of contact over the vault portion, or an overzealousness in the formation of the peripheral seal, may cause the formation of vacuum areas and lead to a false assumption that retention has been gained. To apply just the degree of heat that will produce the result in mind is not so simple as some seem to think. Unevenness of plasticity resulting in unevenness of compression, unevenness of contact resulting in the formation of vacuum areas and overheating resulting in warpage are all liable to take place. Unawareness of the possibility of these errors and the seeming simplicity with which compound can be used has lead to its abuse. For one who is not skilled in its use, better results with less chance of error are attainable when some form of a wash is used in conjunction with the compound.

A comparison of the methods of taking impressions would not be complete without mention being made of the so-called closed-mouth and open-mouth methods. For the closed-mouth technic, bite-rims of compound are added to the partially developed impressions, and by means of these bite-rims, the patient is enabled to apply a biting force during the various steps in the construction of the impression. For the open-mouth technic, force in the seating of the impression is exerted solely by the operator.

The principal advantage claimed for the closed-mouth technic is that the patient can more nearly simulate the amount of stress that is going to be placed on the dentures during function than can the operator exerting force arbitrarily. The objections to the closed-mouth method are: (1) the fact that the amount of force exerted by the patient is not constant and

will vary from time to time; (2) the inability of some patients to cooperate; (3) the time factor; (4) the lack of sufficient working space in some cases, especially those in which the ascending ramus of the mandible is close to the tuberosity of the maxilla, and (5) the danger of overcompression.

In favor of the open-mouth technic, E. C. Pendleton[2] states, "The open mouth technic eliminates the personal equation as far as the patient is concerned and the operation is solely in the hands of the operator."

CONCLUSION

It may be said that there is no one best method. Tissue conditions vary and the method most applicable in the handling of one condition may be contraindicated in the handling of another. Fortunately, materials varying as to their working qualities are to be had, and on account of the varying conditions which may be found in the mouths of different patients, it is not well for an operator to restrict himself to a single material or to a single technic.

Whatever technic or material is used, the personal equation cannot be eliminated. The material and the method used successfully by one man may be a failure in the hands of someone else. The success or failure will depend largely on the keenness of judgment exercised by the operator in analyzing the conditions confronting him and on his selection and manipulation of the materials with which he, himself, in coping with the conditions presented, can best reach the fundamental objectives in the taking of impressions.

2. Pendleton, E. C.: J.A.D.A. 15:1027 (June) 1928.

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Editorials

THE CARE OF CHILDREN'S TEETH

The tendency toward greater emphasis on the necessity of caring for the teeth of children is constantly growing. Though much has been said on this subject, it is a lamentable fact that there is still an appalling neglect in this particular. If this were not true, we would not have the amount of tooth trouble that is apparent everywhere, because the proper observance of mouth hygiene among children would prevent many of the later manifestations of dental disorder in adults. By mouth hygiene, we mean the maintenance, in all of its manifestations, of hygiene of the mouth, which in turn means the suppression of all kinds of conditions inimical to the welfare of the child. We mean the filling of cavities the moment they appear, whether in permanent or deciduous teeth. We mean the elimination of pus, whether from alveolar abscesses, pyorrhea or other infections. We mean the kind of mouth hygiene

that ensures the perfect performance of function and the greatest comfort to the growing child.

Too long the rank and file of the profession have been supine in this particular; too long and too frequently have we heard the vapid remark "It is only a baby tooth"—that pernicious and destructive doctrine that has sounded the death knell of health and function in many a helpless and unfortunate child. For what were these children given to us? To be cherished with solicitous care, or to be condemned to the handicap of neglect and physical disfigurement? In this fair nation of ours, there should be no two answers to this question. It is the inalienable right of every child in America—in the world, in fact—to be vouchsafed the protection afforded it by the prevention of disease and the preservation of health—at least, to the very appreciable extent that this can be brought about by adequate care of the mouth and teeth.

Think of the very great improvement that would be evident in the adult population of this country today if mouth hygiene had been conscientiously maintained in the childhood days of the previous generation. Think of the appalling conditions that we often see as the direct result of the neglect of these same children.

Granted that there are many of our technical problems that we are still unable to solve in our attempt to minister to children, and granted that we get far from one hundred per cent of cooperation from the parent or the child, the patent fact remains that we have fallen far short of our greatest possibilities through failure to devote our best energies to the promulgation of the knowledge that we do possess, or to take advantage of the opportunity for service that has been offered us by the people.

Let us cite the one instance of orthodontia. Too frequently have children been permitted to grow up under the handicap of deformity and lost function simply through neglect on the part of the dentist. Mostly this is the fault of the general practitioner, who ordinarily sees the child before the specialist has had a chance to observe conditions and suggest a remedy. Much of the trouble

and grief which the orthodontist is called on to witness is occasioned by previous neglect on the part of the general practitioner, who has soothed the parent into a sense of false security by instructions to the effect that the child is growing and thus the condition will likely remedy itself. How many a hopeless and pathetic case of deformity has come to the orthodontist, to try his soul and appeal to his humanity, just because some practitioner has spread the doctrine that Nature knows what she is doing and will take care of herself if we just let her alone. With the haphazard heredity of race and the multiple manifestations of environment encountered in this nation, Nature uncontrolled makes a sorry mess of the teeth and mouths of children. And how much of this might be avoided by a little wise direction and a little timely attention when untoward conditions are first noted.

With the enlightenment of the present age, we can no longer seek to absolve ourselves of the charge of carelessness—we were just going to say criminal carelessness—if we fail whole-heartedly to study conditions in the mouth of every child committed to our care. We prate a good deal about prevention in these latter days, and are seriously in earnest when we urge the necessity for prevention; but the pathetic fact is that for the most part we are turning our eyes toward a shadow, when the very substance of things lies close at hand neglected. The only real prevention comes through the medium of early and judicious attention to children.

When the girls and boys of today are given the benefit of the knowledge that we at present possess, and when we devote ourselves with solicitous care to the maintenance of health and the prevention of disease and deformity among the rising generation, then, and only then, shall we stand acquitted of the insistent obligation that is ours, and be able to hold high our heads as a profession worthy the respect and admiration of the world. Toward this happy consummation, we commend the attention of every one of those to whose care children are committed, with the assurance that through the medium of this service lies our greatest opportunity and our most inspiring achievement.

A DENTIST'S CONTRIBUTION TO HISTORY

On another page of this issue, Dr. William J. Gies depicts an outstanding event in world history through the medium of a book written by a dentist of New York, Dr. Maurice William. The title of this book is "The Social Interpretation of History," and Dr. Gies recites the story of how this volume turned the mental current of one of the great Chinese philosophers of the day to another channel, and thereby in all likelihood changed the social order of things in China, as far at least as they can be changed by any one man.

We look on this as a real achievement in world history, and we heartily congratulate Dr. William on having contributed in so concrete a manner to the advancement of contemporaneous thought. The present social unrest in certain centers of the world makes it all the more important that thinking people everywhere study the trend of human thought most carefully, to the end that in our striving for newer knowledge we proceed along the lines of evolution instead of revolution; or as Dr. William recently aptly put it in a personal letter to the Editor, "What we want is social welfare as against class warfare."

We need sane thinking today as we never needed it before, and it is a matter calling for the greatest felicitation that a member of our own profession has been the means of contributing so concretely to the social welfare of humanity. Dr. William is now writing another book in further elucidation of his theories and we look forward to this coming volume with keen anticipation.

WASTE MOTION

Much of the economic incapacity that we hear a great deal about in these latter days may be accounted for on the ground of waste motion. Lack of accomplishment is a serious drain on the economic efficiency of the operator, and much of this is due to lack

of precision in the execution of our technical procedures. To fumble and feel around for a missing instrument is costly in more ways than one. It squanders time, and it causes suspicion that the operator is inefficient. A precise and short cut method of doing things, whereby the operator knows what he is about and accomplishes the most in a given time, is wonderfully reassuring. Waste motion is wearisome in every way, and it is also most expensive. Study system in such a way that the oil of precision prevents the rust of needless waste, and there will be less friction and more accomplishment.

DE LOS L. HILL, D.D.S., F.A.C.D.

(1874—1931)

DeLos L. Hill, of Atlanta, Ga., passed away at his home, May 7, 1931. Dr. Hill had been suffering for approximately two years with high blood pressure, but was confined to his home only a few weeks after heart complications developed.

Dr. Hill was born in Atlanta, May 14, 1874, the son of DeLos Lemuel and Karen Caldwell Hill. He obtained his primary education in the Boys' High School of Atlanta, qualified as an accountant and engaged in accounting for several years before entering on the study of dentistry. He graduated from the Atlanta Dental College in 1903, working his way through college and bearing all of his own expenses. He was honored by being elected valedictorian of his class.

Immediately after he graduated he was elected teacher in the college and had been actively engaged in the development of dental education since that time. He was professor of jurisprudence, ethics and economics in the Atlanta Southern Dental College at the time of his death.

He was a leader at all times in fraternal and dental organizations. He was a charter member of and helped organize the first Psi Omega chapter in Georgia, had organized chapters in many states, for years represented the fraternity in the South and was elected a member of the supreme council in 1914, an office which he retained until 1930, when he was elected supreme grand master.

He was a member of the Methodist Church, a Mason, past master of Piedmont Lodge, No. 447 F. and A. M., Atlanta; a Shriner, Rotarian and a member of the Capital City Club and of the Atlanta Chamber of Commerce. He served as secretary of the Georgia State Dental Society several years before he was elected president in 1913, and was a member of the executive council of the society at the time of his death.

Dr. Hill was, for a number of years, secretary and treasurer of the National Association of Dental Faculties and when this association was amalgamated with the American Institute of Dental Teachers, the Canadian Faculties' Association and

the Faculties' Association of American Universities, and formed the American Association of Dental Schools, he was elected secretary and treasurer of that organization, a position which he filled until 1930, when he was elected vice president. He was promoted to the position of president elect at the meeting which was held in Memphis, Tenn., during the week of March 24 of this year.

He was an honorary member of several state dental societies, a member of the International Fédération Dentaire, a fellow of the American College of Dentists and a member of the Omicron Kappa Upsilon honor fraternity. He was also a member of the National Board of Dental Examiners.

The Fifth District Dental Society was organized in his office. He at one time served this organization as president.

Dr. Hill was married in 1899 to Miss Gussie Parkhurst. Their only child, DeLos Jr., died of typhoid fever at the age of 11, seventeen years ago. Mrs. Hill survives.

Dr. Hill had a wide and intimate acquaintance in the profession. He was a commanding figure in any organization with which he became identified, and he was identified with many. He was active in association work from the beginning, and his influence was always exerted for the welfare of the profession. He was cordial in his friendships and loyal in his affiliations. His frankness was proverbial, and no one ever had to doubt where he stood on any question or in any situation. He was a constructive man and the profession is better for his having been a member of it. His service to society at large was commensurate with what he did for his profession, and thus in every relationship of life he wrought for the benefit of the world.

S. W. F.

J. LOWE YOUNG, D.D.S.

As we go to press, word is received of the sudden death of Dr. J. Lowe Young of New York City. Particulars will be given in the July JOURNAL.

BUREAU OF DENTAL HEALTH EDUCATION

A REPORT ON THE SELF-SELECTION DIET EXPERIMENT IN INFANTS AND YOUNG CHILDREN*

By CLARA M. DAVIS, M.D., Chicago, Ill.

THIS experiment was begun at Mt. Sinai Hospital in Cleveland five years ago, in January, 1926. When I asked for a bed for the purpose, the director of the hospital said, "How long will you want it?" "Perhaps for a few months, perhaps only for a few days," I answered, thinking the experiment might come quickly to an inglorious end. Probably no one is more surprised than I that it has been going on continuously ever since. For two years, it was carried on in the hospital with one and, later, two infants. Then, private generosity made possible the establishment of a nursery in Chicago for continuing the experiment on a larger scale, and there, during the past three years, we have been able to continue the experiment with fourteen infants.

The experiment was not planned to prove any theory regarding feeding or nutrition. We merely wished to find out whether infants who were of weaning age, who had had no previous experience with solid foods and, therefore, had no food habits in respect to them, could or would choose their own foods without suggestion or help from adults, and if so, what and how much they would eat, and what would happen to them. We have experimented with but fifteen infants in all, choosing to work with a small number for long periods of time rather than a large number for short periods. Two have completed periods of six months each, the other thirteen, periods of from one to four and one-third years. These fifteen infants have eaten more than 25,000 meals, of which we have the complete records in weighed and measured quantities.

Table 1 lists the foods used in the experiment. It was not made up with any idea as to what might or might not be good for babies. We chose foods that could be obtained fresh in the market the year around so that any question as between canned and fresh foods would be eliminated. All the edible animal products are represented, meat, glandular organs, bone marrow, even the skin of the chicken being used. Milk is served both sweet and soured by ordinary lactic acid bacilli. The cereals are whole-grain products, most of them ground by the old stone process. In order to keep the experiment to its simplest terms, the list does not include any derived or especially refined products such as butter, cheese or sugar, and even the salt is a natural one, sea salt. Beef, bonemarrow, eggs, carrots, peas and apples are served both raw

*Read before the Section on Orthodontia at the Midwinter Clinic of the Chicago Dental Society, Feb. 4, 1931.

and cooked, the other fruits raw and the other meats and vegetables cooked. This cooking is done as simply as possible without salt or other seasoning, the vegetables and meats in low-pressure steam cookers without added water or loss of soluble substances.

Since we wished to avoid the possibility of any infant's choosing anything he really did not care for, because it was combined with things he liked, all made dishes such as breads, soups and custards, are excluded. All solid foods have been finely cut up or mashed before serving.

In the beginning, four meals a day were served during a baby's first few months on the experiment, but, for the past four years, all infants, regardless of age, have had from the first day only three meals a day with nothing except water between meals. What each meal consists of is given in Table 2. All portions of food have been weighed or measured before serving and each, even salt, has been put into a separate dish. The dishes have been placed on a large tray and each refilled as soon as emptied so that the baby could have all he wanted of everything. At the end of the meal, the remaining food has been weighed in order to determine the amounts actually eaten. (Fig. 1.)

It had been decided to take breast-fed infants only for the experiment in order that they might have a nutritional background as nearly uniform as possible, but to obtain such babies proved far from easy. Mothers and institutions with babies to be placed, when they learned what the experiment was, instantly remembered that other arrangements for the baby were pending and intimated that it would be best for me to look elsewhere. Finally, Earl H., a 9 months old breast-fed baby was secured. Having spent his life in an institution, he had never seen solid foods served or eaten. Naturally, when he had had his last meal from his mother's breast, we did not expect him at his first sight of food in dishes to say "I choose this" and to pick up a spoon and feed himself, but we did

TABLE 1.—FOODS USED IN EXPERIMENT

1. Meats (muscle cuts):
   - Beef
   - Lamb
   - Chicken
2. Glandular organs:
   - Liver
   - Kidney
   - Brains
   - Sweetbreads (thymus)
3. Sea food:
   - Sea fish (haddock)
4. Cereals:
   - Whole wheat (unprocessed)
   - Oatmeal (scotch)
   - Barley (whole grains)
   - Corn meal (yellow)
   - Rye (ry-krisp)
5. Bone products:
   - Bone marrow (beef and veal)
   - Bone jelly (soluble bone substances)
6. Eggs.
7. Milks:
   - Grade A raw milk
   - Grade A raw whole lactic milk
8. Fruits:
   - Apples
   - Oranges
   - Bananas
   - Peaches or pineapple
9. Vegetables:
   - Lettuce
   - Cabbage
   - Spinach
   - Cauliflower
   - Peas
   - Beets
   - Carrots
   - Turnips
   - Potatoes
   - Tomatoes
10. Incidentals: Sea salt (seisal)

make careful arrangements for the meal so that if he got anything to eat at all, it would be only what he himself chose.

He was seated in an arm chair at a small, low table, and the tray with its rows of dishes and a spoon for him, to use if he wished to try was set before him. A nurse sat in a low chair beside him with a spoon in her hand. (Fig. 2.) Her orders were to sit quietly by and not to interfere with anything the baby did. She might not speak to him, call his attention to any food, offer him any or refuse him any for which he reached, comment on what he did or attempt to teach him table manners. Only when he reached for or pointed to a dish was she to take up a spoonful of the food and, if he opened his mouth for it, put it in. Since the dishes on the back row were out of reach of his short arms, she was to change the position of the dishes on the tray two or three times during the meal. This procedure has been followed with all the babies until they were able to feed themselves.

At his first meal, Earl H. promptly put his hand in a dish, opened his mouth and looked at the nurse, who took up a spoonful and, as he leaned forward for it, put it in his mouth. An expression of complete surprise passed over his face, but he chewed the food awkwardly and swallowed it. Then he put his finger in another dish and sucked his finger. Then he banged the dish impatiently with his hands and looked again at the nurse, who

TABLE 2.—SELF-SELECTIVE DIET FOR CHILDREN

7 a. m.

Milk, grade A
Milk, lactic
Sea salt (seisal)
Apples, raw
Apples, cooked
Orange (juice or pulp)
Wheat, raw
Wheat, cooked
Barley, cooked
*1. Brains, cooked / Kidneys, cooked
2. Sweetbreads, cooked / Liver, cooked

*1 and 2 served on alternate days, never on the same day.

12 m.

Milk, grade A
Milk, lactic
Seasalt(seisal)
Ry-krisp
Bone marrow, raw
Bone marrow, cooked
*1. Beef, raw / Beef, cooked
2. Lamb, cooked
3. Chicken, cooked
†4. Lettuce, raw / Potatoes, cooked / Beets, cooked
5. Carrots, raw / Carrots, cooked / Turnips, cooked / Cauliflower, cooked
6. Cabbage, raw / Cabbage, cooked / Spinach, cooked / Peas, cooked / Peas, raw / Cornmeal, cooked.

*1 and 2, 1 and 3, 2 and 3 served on successive days.

†One group of three vegetables served each day (4, 5 or 6).

5 p. m.

Milk, grade A
Milk, lactic
Sea salt (seisal)
Ry-krisp
Oats, raw
Oats, cooked
Bone jelly
Fish
Eggs, raw
Eggs, cooked
Tomatoes
Banana
Orange
Pineapple or peach

gave him a spoonful of it. Some things he tried and spit out or allowed to run out of his mouth. The expression of his face showed clearly whether he liked a food or not. At his first meal, he ate: 8 gm. of cooked beef, 35 gm. of cooked carrots, 10 c.c. of sweet milk, 105 c.c. of lactic milk and 3 gm. of lettuce.

Why he chose what he did or why any baby chooses what it does is as much of a mystery today as it was then. Earl continued on the experiment for six months, during which time he throve and then, having contracted whoopingcough in the ward, he had to be sent to the contagious disease hospital, this ending the experiment in his case. Soon, we obtained two other babies, Abraham G. and Donald R., who remained for a year at Mt. Sinai Hospital and, when the nursery in Chicago was opened, were transferred to it. They are still on the experiment and are the oldest children that we have in the nursery.

In the hospital, these babies had had their meals at different hours and, for fear of the influence of example, had never been allowed to see each other eat. At the nursery, with a number of babies and the impossibility of having different eating hours for so many, they have been fed simultaneously, each at his own little table in the general dining room. We have not been able to detect the slightest influence of one on the other in respect to choice of food or manner of eating. We had wondered during the early days of the nursery whether, as the babies became run-abouts, we might not be treated to occasional rough houses in the dining room, with dishes or food thrown about, or children getting down and snatching from each other's trays, but nothing of the sort has ever happened.

Before each meal, hands and faces are washed, then the dietitian comes in and says that the trays are ready, and all who can walk join in an eager rush to the dining room, the nurses carrying the youngest ones. Bibs are tied on and the trays brought in. Since they may eat with their hands or in any way they can, these babies soon become independent eaters, and by the time they are 15 or 16 months old, the functions of the nurse are reduced to moving dishes that the babies cannot reach and seeing that empty dishes are promptly refilled, so that one nurse seated between their tables can attend to two infants. From the age of 20 months, all the babies thus far have been able not only to feed themselves entirely, but

Lactic Milk Whole Milk Cooked Marrow Raw Beef Cooked Beef
Chicken Sea Salt Ordinary Salt Carrots Raw
Cooked Turnips Cauliflower Rye Krisp

Fig. 1.—Tray ready for serving to infant.

also to rearrange their dishes on the tray to suit themselves and to hold up the empty ones to attract attention when they wish more of what was in them. The older babies have only waitress service, no nurse sitting beside them. When a baby is through eating, he gets down or is helped down and leaves the dining room regardless of whether the others have finished.

Under this régime, there being no conversation and each adult maintaining an entirely impassive demeanor without the slightest show of interest in what the babies eat or how they behave, the babies have given their undivided attention to their food. Eagerly and happily, they fall to and eat without haste and without dallying, small legs swinging under the tables as the feeling of well-being that comes from the satisfaction of hunger permeates them and free from anxiety as to whether or not they can have all they want of everything. This almost pagan joy in eating, the poise of the babies during meals and the entire absence of emotional strain and behavior problems, as well as of anorexia, reminds one of young animals or of the eating habits of primitive peoples where food is plentiful and easy to get. An unexpected by-product of the experiment, as it were, this has been to us one of the most interesting things that we have observed throughout its course. For the nurses, meal hours are the most quiet and restful periods of the babies' waking hours.

TABLE 3.—PROTEIN, CARBOHYDRATE AND FAT PER KILOGRAM OF BODY WEIGHT FIRST SIX MONTHS

	Highest	Lowest	Average (11 infants)
Protein	6.10 (A.G.)	3.06 (A.B.)	4.69
Carbohydrate	18.64 (D.R.)	7.89 (J.B.)	12.90
Fat	7.86 (A.G.)	2.99 (A.B.)	4.72

At their first few meals, the babies usually try to eat in a number of different ways. They try to put their faces into the dishes and eat, sometimes even trying to lap up the food like little dogs; they pick the dishes up and turn them over their faces in an attempt to pour the food into their mouths; they often get the food in a tightly closed fist which when carried to the mouth they are unable to open, the grasping reflex being still present. Unless a baby's hand-to-mouth coordination is unusually well developed, he has to resort to pointing to the food and then waiting for the nurse to put it into his open mouth. Pointing, at first, is usually done with the whole hand, sometimes with both hands, but later is usually done with the index finger or thumb. When they first try to use a spoon, it usually reaches the mouth upside down with the food falling out. New ways of eating, such as using a spoon, are not practiced until the latter part of the meal after the first ravenous hunger is appeased. No milk is poured on the cereal served them, but, after a few months, all of the babies have begun to dip their pieces of "ry-krisp" in milk, and frequently they dip other foods such as carrots, peas, potatoes and even meat. This dipping of food in milk or water is practiced by animals also, the raccoon, the monkey and even the crow, so that it does not indicate a particularly high degree of development. We have been much interested in the babies' eating of salt. No baby has eaten salt every day and, in the early months, they have not put salt on any foods, but have eaten it separately, the nurse taking up a small amount on the end of a spoon when the baby reached for it and putting it in his mouth. Even one-tenth teaspoonful of salt in the

mouth is quite biting, and it has not been uncommon to hear a baby cry lustily, tears rolling down his cheeks, but the babies have never tried to spit it out, have swallowed it after a minute or two of sputtering and choking and, strange to say, have gone right back for more, cereal. Curiously enough, they seldom add salt to their meats.

Each meal consists of from eight to eleven separate articles, and, during the first week or two, every baby has tried everything on the list, not once but two or three times. By the end of that time,

Fig. 2.—Meal in progress.

repeating the process until they have had enough. One or two have promptly learned the trick of reaching for their milk immediately after taking salt and washing it down with that. Later on, they dip apples and vegetables in salt or add salt to their milk or to milk and having sampled all the available foods, they show definite likes and dislikes. Thereafter, when the tray has been brought in, they have looked it over quickly and reached promptly for what they wanted, regardless of its position on the tray, usually making their meal of

three or four articles and ignoring the others. The variety in their tastes has been amazing, two of the fifteen showing the same combination of likes and dislikes, and, in the beginning, they often thoroughly shocked us by what they chose to eat. It was not only shocking but also a cause of real anxiety to have two infants, after the first period of experimentation with the foods, take no more milk for periods of five and ten months respectively. One of these, Anne B., lived almost entirely on orange juice (taking about a quart a day), glandular organs, bone marrow and egg yolk; the other, on fruit, vegetables and meats; yet they throve as well as the others. It was just as surprising when, after the long period of abstinence from milk, they began to take it again and drank as much as did the other infants in the nursery.

Another real alarm came when Abraham G., at the age of 13 months, began an "egg jag." For a day or two, he ate two or three eggs for supper; then one evening, while making a call, I was called to the telephone and the anxious voice of the head nurse on the ward said, "Abraham has eaten five eggs for supper." There was such alarm in her voice that I quickly asked, "How sick is he?" "He isn't sick," she said, "he has gone to sleep, but what shall we do?" I told her to have him watched carefully and let me know if anything happened. In the morning, he was his usual happy, husky self. That night, he ate four eggs, and he continued to eat three or four eggs for several evenings, coming down gradually to one or two, as he had previously eaten. Since then, he has had several waves of egg eating, and, during one, when he was 2½ years old, ate ten eggs for supper one night, with no ill-effects whatever. Such waves of eating one particular food (Figs. 3-4), meats or

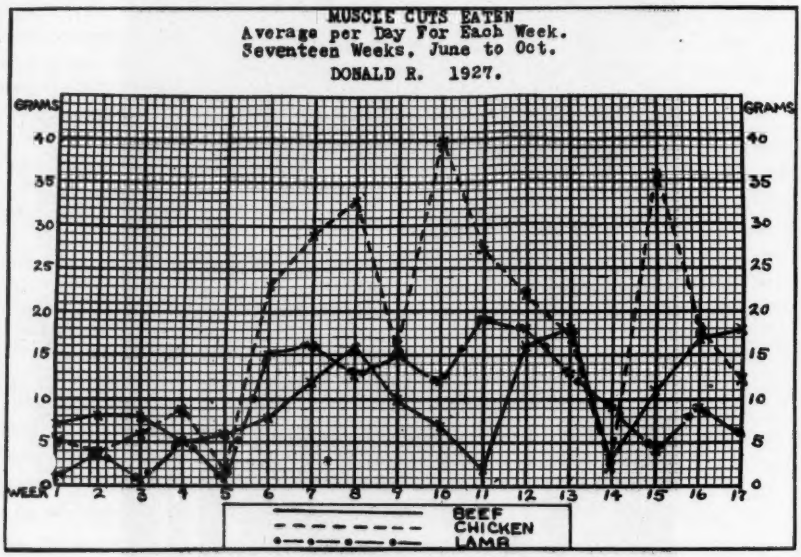


Fig. 3.—Meat eating "wave" of Donald R.

a fruit for example, when, from a fairly constant previous level, there has been a gradual rise in the amount to a quite appalling maximum, followed by a gradual decline over several days to the previous level, have been observed in several of the infants. I have no explanation for them.

We had wondered what would happen if we chanced to get a baby that had eczema or was known to be allergic to a definite food. We found out with Anne B., who had a facial eczema which her mother told us spread rapidly over the baby's body if she herself ate even so much as the meringue on a piece of lemon pie. On Anne's tray, therefore, the yolks of the hard-boiled eggs were removed from the whites, and placed in the same dish. At her first meal, she ate the yolk and tried the white, but spit it out. Thereafter, during the first two months, she ate the yolks each day and occasionally a few grams of the white. Her facial ezcema almost, but not quite, disappeared. During the remainder of the year that she was in the nursery, she ate no more egg white, usually picking the whites out of the dish and throwing them on the floor at the beginning of the meal, and she was entirely free of eczema.

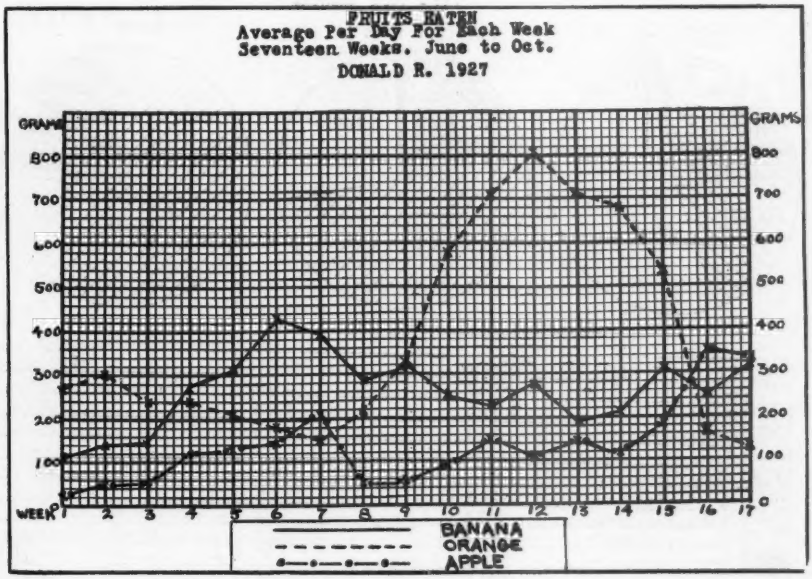
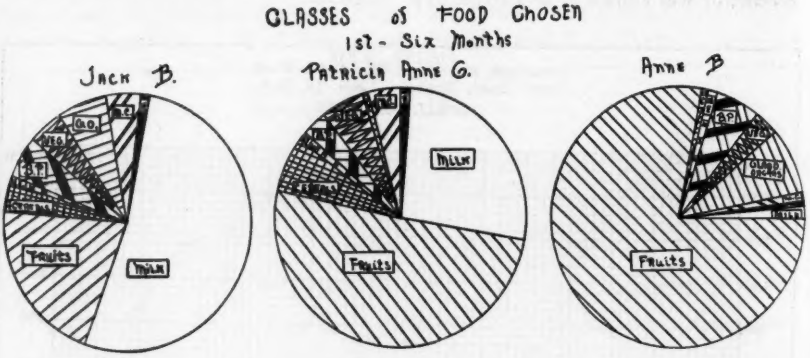


Fig. 4.—Orange juice drinking "wave" of Donald R.

The amount of fruit consumed by these infants has been enormous. Fruit has constituted nearly 50 per cent of the intake as measured in grams or cubic centimeters of some, and with two infants, 70 per cent and 75 per cent. Infants from 12 to 14 months of age have eaten two or three bananas in addition to other food for supper and have occasionally drunk over a pint of orange juice

at a meal. (Fig. 5.) Some of the meals chosen have seemed decidedly odd, such as a breakfast of apples and liver, a supper of orange juice, bananas and milk, or a noon meal of raw beef and lactic milk. In general, muscle cuts of meat, potatoes, carrots, peas, eggs, apples, oranges and bananas and milk, have been well liked by most of the babies, as they are by most adults. Bone marrow has been a favorite



GLASS of FOOD	PERCENT	PERCENT	PERCENT
Milk	52.85	27.4	1.52
Fruits	22.44	51.4	78.50
Cereals	2.43	6.6	.28
Eggs	.50	.7	1.25
Bone Products	5.19	3.1	5.55
Vegetables	5.26	5.8	3.13
Glandular Organs	5.83	.2	8.35
Muscle Cuts	5.45	4.1	1.04
Sea Fish	.50	7	.38
	100.00	100.0	100.00

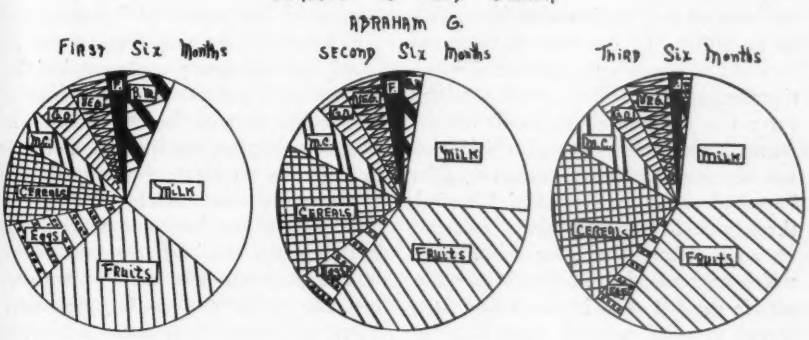
Fig. 5.—Variety of choice shown by three infants.

article during the first few months after weaning, when babies have occasionally eaten from 75 to 90 gm. of this fat at one time; so that one wonders about fat tolerance in infants of this age. Instead of cereals forming the backbone of the diet as they have in many prescribed diet lists, they have been rather neglected by most of the younger infants, rarely constituting more than 8 to 10 per cent of the total food intake, although two cereals have been served at each meal. Cereals constituted but 0.25 per cent of the food taken by one baby during his first six months period. Usually, as the babies have grown older and have had more vigorous exercise, they have taken more cereal, although it has never been the major part of the diet of any one of them. (Fig. 6.) With some humiliation, I confess that these untutored infants have almost entirely failed to appreciate spinach and lettuce, which, with turnips and barley, have proved to be the most unpopular articles on the food list.

We have not found that the babies' tastes remained fixed or that there appeared in their eating any tendency to

fixed quantities or regular proportions of the different foods. The idea of the so-called "balanced meal" has apparently never entered their heads. Even the one who lived on orange juice, bone marrow, glandular organs and egg yolk during her first six months, began to eat potatoes, peas, muscle cuts of meat and milk during her second six-months period. gm. of baked potato and 1 quart of lactic milk. Such large meals are often followed by a small meal, but, in general, the babies have had marvelously good appetites, and their total food intake has been greater than has usually been thought advisable.

How have the babies fared? Coming as they have from the poorest homes of



	PERCENT	PERCENT	PERCENT
Milk	30.1	23.5	22.4
Fruits	27.9	34.7	34.7
Cereals	10.3	16.9	21.2
Eggs	8.3	4.9	3.8
Bone Marrow	6.1	2.2 Bone Products +	0.7
Vegetables	5.6	5.0	6.0
Glandular Organs	4.9	3.6	3.9
Muscle Cuts	4.2	5.8	5.8
Sea Fish	2.6	3.4	1.5
	100.0	100.0	100.0

Foods measured in Gm and Cc + Bone Jelly and Marrow

Fig. 6.—Chart showing increase in amount of cereals eaten with increasing age.

And the others have, quite unpredictably, changed in many of their likes and dislikes.

The quantities eaten at different meals have also varied widely, and many truly enormous meals have been eaten. One wonders where the food goes when a 3-year-old boy who has been playing out in the snow tucks away for lunch 750

a large city and from institutions, only four of these breast-fed infants were of normal weight for age and in perfect health at the time of beginning the experiment. Two had active rickets and two had pyelitis with an acute exacerbation soon after admission; yet all have flourished, and their gain in weight has equaled or surpassed the best standards.

They have been exceptionally free from digestive disturbances of every sort. No one has ever been constipated and no laxative has ever been given to any of them. There have been four instances of mild diarrhea, all in connection with severe parenteral infection and in babies under 1 year of age (the four who had rickets or pyelitis at the time of beginning the experiment), and there have been a few instances of vomiting, once at the onset of an infection with fever, such as tonsillitis. In the four instances of diarrhea accompanying parenteral infection mentioned above, trays were omitted for a few days, until the stools became normal. Otherwise, through chickenpox and whoopingcough, which the two older boys had while in Mt. Sinai Hospital, through colds and through the epidemic of acute glandular fever of Pfeiffer which affected all the babies in the nursery in the fall of 1928, trays have been served as usual without regard to the height of fever, and the babies have continued to run their own dietary affairs without upset of any kind, although naturally the amount eaten was considerably less.

Their red blood counts and hemoglobin have shown a high average, the former being as a rule around 5,000,000, although counts of 5,600,000 and 6,000,000 have not been uncommon, while the hemoglobin has averaged from 95 to 110 by the Sahli hemoglobinometer.

Two of the infants had acute clinical rickets of considerable severity when taken for the experiment and neither had ever had cod liver oil. One of these was Earl H., our first baby, whom we had taken not from choice but because we could get no other. We had not intended to give cod liver oil to any baby while on this experiment, but it was winter, and the one condition made by the hospital director in granting a bed for the experiment was that the experiment must not be conducted in any way detrimental to the baby. In view of this fact, it was decided to put cod liver oil in a small glass on his tray for him to take or leave as he pleased, and also to add S. M. A., which contains cod liver oil, to his list of milks. To our surprise, he took them during the first 101 days, not regularly nor in measured doses but to the total amount of 256 c.c. or 68 5/6 drams of cod liver oil. At this time, when his blood calcium and phosphorus had become normal and the roentgenograms of his wrists showed healed rickets, he stopped taking any cod liver oil, and after it had been on his tray untouched for two weeks, it was removed. During this time, he had not been out doors or received any ultraviolet ray treatments. This baby is the only one that has ever had any cod liver oil during the experiment, and several have never had any in their lives.

The second infant with rickets, Peter C., was admitted in April, 1929. He was 7 months old, anemic and thin, weighing only 13½ pounds, and so weak that he could not sit up and had to be tied in his chair when at table. His legs were badly bowed and all his epiphyses enlarged. No cod liver oil was given to him or placed on his tray. During the first six months, he lived chiefly on chicken, bone-marrow, meat, vegetables and fruits. He is the baby who, after the first two weeks, did not take any milk for ten months. Cereals constituted about 0.25 per cent of his food intake during the first six months. He was not given any light treatments. Roentgenograms taken toward the end of the fourth month showed his rickets to be healed and now (a year and a half later) his legs show practically no bowing.

What kind of permanent teeth these children will have is, I think, one of the most interesting questions that can be raised. I only wish that we could keep them all until adolescence under these experimental conditions and with competent dental observation, but such an undertaking would involve an expense that we cannot meet. With regard to their first teeth, I can say only that all have been well formed and, thus far, no caries has been observed. One of the older boys at 2 years of age had a poorly developed lower jaw with malocclusion that, in the opinion of the consulting dentist, would require mechanical correction. These conditions have improved to such a degree that now (at the age of 4½ years) it seems unlikely that any corrective measures will be needed. While it is quite possible that this might have occurred under any dietary conditions, anyone with a hospital or dispensary service cannot but be struck by the high incidence of facial asymmetry, maldevelopment of lower jaws and poor occlusion among malnourished infants and children.

From the point of view of bone and tooth development, and making all due allowance for the fact that the experimental food list does not include any refined, vitamin-poor foods such as sugar or white flour, perhaps the most interesting point that emerges from the statistical study of what these children have eaten is that they have tended toward an almost uniform acid-alkali balance in their food intake, and that this is very close to that known to be optimal for the calcification of bone in the presence of an adequate calcium and vitamin supply.

When one considers merely how and what these babies have eaten, it all seems chaotic and without rhyme or reason. But when their food records are analyzed in terms of protein, carbohydrate, fat and calories per kilogram of body weight, orderly relations begin to appear. True, their protein, carbohydrate and fat intakes are not in very close accord with commonly held ideas as to what children of this age should take, their protein, for example, being much higher, i.e., 4.6 gm. per kilogram of body weight, and their carbohydrate lower, but even the protein figure is very close to that which Wang and her coworkers found in their experiments to be optimal for much older, undernourished children; i.e., 4 gm. per kilogram of body weight.

Why these children have chosen as they have and flourished without benefit of adult advice or direction as to what to eat, and are active, vigorous and healthy, remains in the realm of theory. It may simply be that the young child's factor of safety with respect to these simple foods is much greater than has been commonly supposed. Ten years ago, one might have invoked "instinct" as an explanation. I understand that the psychologists have recently abolished instinct, declaring there is no such thing, so I can only say that the impression I have received from watching these babies is that there has existed in them some mechanism made evident as appetite, which, sensitive as a weather vane to every wind that blows, has responded promptly to heat, cold, exercise, fatigue and infection, and which, when uninterfered with by emotional conflict with elders or suggestions from without, has functioned smoothly and efficiently as far as the simple unmixed foods of this list go.

CONCLUSION

May I emphasize that this has been and is simply an experiment. As conducted, it is not a feeding system, being

both wasteful and impractical from any but an experimental point of view. The results of the experiment seem to me to raise some practical questions, of which among the important ones are: 1. Can the likes and dislikes of the infant and young child be of help instead of a hindrance in his feeding? 2. Once it has been decided what foods a given child may eat, is it sound practice or psychology to so particularize in amounts, and in table manners, that a running fire of interference, suggestion, direction and diversion must accompany each meal in order that meals shall exactly meet blueprint specifications?

ROENTGEN RAYS IN CHILDREN'S DENTISTRY*

By CHARLES L. DRAIN, D.D.S., Iowa City, Ia.

THE value and importance of the roentgen rays in dentistry as an aid in diagnosis is well recognized. The past decade has witnessed an ever-increasing demand for its use, evidenced, for instance, by the numerous x-ray laboratories which have sprung up, almost mushroom-like, in most of our cities.

As we analyze the literature during this time, it is apparent that the use of the dental roentgenogram has been confined, in general, to certain definite fields. Further analysis reveals that, for some obscure reason, the profession has limited the study of roentgen-ray problems to certain age groups. The adult practice has received the greatest attention. Only one specific reference to the use of the roentgen rays in childhood in the last indication that we are neglecting a most decade, was found. This is only another important field—child dentistry.

The popular conception of the roentgen rays even among dentists seems to be as a means of detection of septic teeth. "Radiology," says Simpson,[1] "has innumerable neglected applications which are more cheerful to contemplate and gratifying to apply."

The roentgen rays serve many useful purposes during the childhood period. Unfortunately, because of the general lack of serious consideration for children's dentistry, a large part of our diagnostic procedure for the child is carried out with the exclusive use of a mouth mirror and explorer. This, many times, is hurriedly completed, with little consideration for the future of the patient. Few progressive practitioners consider a dental examination of adult patients complete without the aid of the roentgen rays. Yet a large proportion of these men neglect to make even a thorough manual mouth examination for their child patients.

As the child develops from the infant, through childhood to the fully grown adult, certain definite processes must be carried forward if the normal is to be attained. The uncertainty with which

*Read before the Section on Mouth Hygiene at the Midwinter Clinic of the Chicago Dental Society, Feb. 3, 1931.

1. Simpson, C. O.: Radiography in Operative Dentistry, J.A.D.A., 11:12-16 (Jan.) 1924.

some of the dental development proceeds makes it an impossibility to observe or treat the case intelligently without the aid of the roentgen rays. Simpson[1] suggests that "after 6 years of age, periodic examinations are imperative to the best interests of the individual."

The premature loss of deciduous teeth is one of the most frequent causes of malocclusion. Its reduction can be effected only by the intelligent application of all preventive measures, among which we count the use of the roentgen rays. The wide variations in the eruption of teeth, the sometimes unfortunate accidents occurring to teeth during childhood and the progress of calcification and decalcification are most effectively checked with the aid of the roentgenogram. The treatment of deciduous teeth is many times determined by the development of their successors.

Detection of incipient caries should be the paramount consideration in patients of all ages, and especially during the childhood period, since the early effects of extensive dental destruction are not easily erased. Early recognition and prompt correction of the predisposing causes and beginning lesions of caries constitute the most practical method of coping with the disease. Since the progress of caries produces a chain of sometimes serious complications, and the success of operative procedure is limited by the amount of destruction, vigilance is the key to prevention. The susceptibility of the proximal surfaces of teeth to caries is exceeded only by that of the occlusal surfaces. Since it is most difficult to examine these surfaces thoroughly, it would seem advisable to adopt some suitable method of examination involving more than manual means. Such a method has been recommended by Raper,[2] using the bite-wing roentgen-ray film technic. Whether this or any other method is employed, the principles of preventive dentistry are involved, and successful treatment depends largely on the procedure followed after diagnosis.

Prolonged retention of deciduous teeth is not infrequent. In some cases, permanent successors are not present; in others, the permanent tooth is either held back or deflected from its line of normal eruption. Rarely, we find deciduous teeth retained so long that even though they are extracted, the successor is unwilling to take its place. The recognition, proper diagnosis and early treatment of these cases will later be appreciated.

Not infrequently, we see cases of a seemingly arrested development in certain regions of the deciduous dentition, cases in which we note an infraclusion of the teeth in the area affected. It is apparent that they are being passively carried forward instead of playing an active part in development. In the majority of these cases, normal shedding will not take place. The roentgen rays are an essential aid in the treatment.

The detection of impacted permanent teeth during the childhood period is very important. In a large percentage of these cases, orthodontic treatment will bring an otherwise useless and ofttimes dangerous tooth into active service for the patient. The value of the roentgen rays in these cases is apparent, many roentgenologists recommending the use of steroscopic films.

In cases of pulp involvment, either of deciduous teeth or the permanent teeth, during the childhood period, the roent-

2. Raper, H. R.: Practical Clinical Preventive Dentistry, J. A. D. A., 12:1084-1100 (Sept.) 1925.

gen-ray examination should be employed. There are some cases in which this is obviously unnecessary, but certainly routine roentgenograms should be made in all cases if pulp treatment of any kind is to be undertaken. Regular check-up examinations should be made after the successful treatment has been concluded.

The interpretation of roentgenograms brings many complications and conflictions. Roentgenologists in general have given us little constructive material on which to base the reading of roentgenograms during childhood. To be sure, it has been considered but superficially, so that there exists no accurate technic for children.

Obviously, there are mouth conditions encountered during this period in which interpretation and diagnosis are not difficult. The presence of supernumerary teeth or of remaining deciduous roots, etc., is easily detected and the diagnosis relatively simple. Determination of the correct time for extraction of deciduous teeth the roots of which are not absorbing properly and the interpretation and diagnosis of pulp involvement cases are not so simple.

During childhood, we have some conditions peculiar to the period which may alter interpretations and thus lead to an incorrect diagnosis. These are the conditions, normalities if you please, which roentgenologists have failed to amplify. The presence of both the deciduous and the permanent teeth, the less dense supporting structure and the normal processes of calcification and decalcification make correct readings more difficult.

We may ask, does the nature of the tissues during childhood alter interpretation and diagnosis? We know, for instance, that the tissues, both tooth and supporting, are young, developing and very vascular, and are therefore, normally, more resistant to infection and less resistant to the penetration of the roentgen rays. Increased vascularity normally points to a more rapid diffusion of infection, and young, developing tissue usually offers added resistance to infection. Failure to recognize these conditions in the child may alter interpretation. These considerations, in addition to the difficulties already mentioned, make one wonder whether interpretation and diagnosis during childhood should be made on the same basis as for the adult period. While I believe the roentgen rays to be a valuable accessory to children's dentistry, I do feel that we need a better basis on which to explain roentgenograms for our child patients.

The dentist who numbers children among his patients should recognize that the roentgen rays are as valuable in these cases as among his adult clientele. Indeed, they are essential. The history, examination, age and health of the patient are likewise important.

Give to your child patients the same careful professional service that your most difficult adult case demands.

WHAT IS THE ECONOMIC VALUE OF DENTAL HEALTH TO THE COMMUNITY?*

By ARNOLD H. KEGEL,† M.D., Chicago, Ill.

IT is difficult for any of us here today, trained in the art of healing, to think of health from the standpoint of community economics. Yet the varying degrees of health exert a tremendous influence on our economic status.

There has been a noticeable tendency on the part of many medical writers recently to explore this hitherto unknown avenue. Particularly is this true of those writers whose association and experience with insurance or industrial groups have made research in this field possible. It was not until medical statistics covering large groups were available that any national estimate was possible regarding the relationship of disease to community affluence or well-being. Even so, the dearth of authentic material is pathetic. It will take many years of careful research and compilation and weighing of statistics before the true significance of this relationship is known.

The material wealth of a community depends largely on the general health of its citizens. By that, I mean that the true wealth of any community cannot be measured by material substance alone. Human capital is a community's greatest asset. That type of asset is limited only by the creative and productive ability of individuals. When that ability is lessened through calamity such as war or pestilence, the economic status falls. Conversely, when the health standards are raised, the material wealth increases. Life and health have a much higher and deeper value for us than money. They modify every possession; they give value to everything else.

Thus, we might say that every community is possessed of two kinds of capital, material capital and living capital, the former depending on the latter, and the latter much more important than the former. Both types of capital are modified by illness and accidents. Illness is one of the commonest and most disturbing facts in life. Recent statistics show that, at any given time, 2 per cent of our inhabitants are ill. The average individual in the United States loses about seven days each year from sickness involving inability to work. There are additional days of discomfort which interfere more or less with one's duties and productive ability, an accurate estimate of which would be impossible.

Two per cent loss of current production in the United States amounts to approximately $1,250,000,000 annually. To this figure must be added the cost of such items as medical care, hospital service, drugs and associated items. It is estimated very conservatively that the annual cost per capita for medical care, including all items, is $10, or more than a billion dollars per year. This, added to the sum lost

*Read before the Section on Dental Economics at the Midwinter Clinic of the Chicago Dental Society, Feb. 4, 1931.

†Commissioner, Chicago Department of Health.

in wages and reduced production, brings the annual cost of sickness of the American people to more than $2,250,000,000.

This does not take into account the enormous economic loss due to premature death from entirely preventable causes, which, it is estimated, amounts to more than six billions annually.

How much of this enormous loss can be charged to oral infection? There can be no doubt in the minds of any one, even remotely associated with either the medical or the dental profession, that dental disease both directly and indirectly is responsible for much of this two and one-quarter billion dollar loss each year.

As a result of improvement in the standardization of records during the past twenty years, statisticians can estimate, with a fair degree of accuracy, the economic loss caused by most of the major diseases. Knowing the death rate from heart disease, tuberculosis, nephritis, diphtheria or typhoid, it is a simple matter for one to compute the annual loss to the community from any or all of these illnesses.

Because of the inadequacy of reliable statistics and scientific data, it is impossible for even the most reliable investigators to estimate accurately the economic loss to the community which is attributable to dental disease.

Dental disease affects our community directly by our enormous dental bills each year. It affects us indirectly through its modifying influence on both our physical and our mental health. It is much easier to estimate the direct than the indirect influence of dental disease on our economic status.

If we assume that there are 3,500 dentists in Chicago, and that their average gross income is as low as $4,000 annually, or $333 a month, we can estimate that it is costing our community in its search for that elusive rainbow, dental health, a matter of $14,000,000 a year. If we add to that figure the money spent by the department of health, the Cook County Children's Dental Clinic, and the board of education for the care of children's teeth, conservatively we can place our figure at between $14,500,000 and $15,000,000. While $15,000,000 is a goodly sum of money, it is not a large amount for the citizens of a city the size of Chicago to pay for dental service. Furthermore, it is nothing compared to the sum we pay indirectly annually as a result of dental infection.

The indirect financial loss to a community due to diseased teeth must be enormous, although no one can say definitely what that amount may be. So many different factors must be considered that it is impossible to arrive at a satisfactory conclusion. Dental disorders, by causing both physical and mental disorders, are the cause of great community waste each year.

Heart disease is now first in the list of causes of death. It is also first in the amount of damage done through producing disability and invalidism. In the United States, the deaths of nearly 200,000 persons are ascribed to it each year. One out of every six deaths in the United States in 1929 was due to heart disease. Altogether, 2,000,000 people in the United States, or about 2 per cent of the entire population, suffer from some form of heart trouble. Many of them cannot engage in productive activities and are a drain on the resources of the people to a greater or less extent. It outranks tuberculosis, pneumonia and cancer as a drain on the human resources. In 1929, it caused the death of 7,489 people in the city of Chicago.

Organic heart trouble is one type of the disease which is commonly due to dis-

eases of an infectious nature, usually contracted in childhood, such as rheumatism, chorea, diphtheria, scarlet fever and typhoid fever. Obviously, diseases of the tonsils and of the teeth both affect the heart.

It is hoped that, in the near future, a closer and more scientific study of this subject will produce some definite and accurate statistics regarding the true relationship between dental decay and heart lesions.

Epidemic infections are the cause of heart disease during the earlier years of life. Infections of a chronic nature are responsible for much of the heart disease in later life. This type of infection works insidiously and often radiates from foci in the head, such as from the teeth, tonsils, middle ear and nasal sinuses.

Examination of school children by the Chicago Department of Health showed that out of 570,000 children, more than 11,000 or approximately 2 per cent were suffering from heart trouble.

During 1929, only sixteen children under 1 year of age died of this disease; 138 children in the age group of from 1 to 9 years died of heart disease, while 208 children between the ages of 10 and 19 were heart disease victims. In other words, 50 per cent more children died of heart disease between the ages of 10 and 19 than between 1 and 9 years of age.

There has been a noteworthy decrease in deaths from heart disease in children under 5 years old, also a slight decrease in the 5 to 9 year group. In the 10 to 14 year group, there has been a noticeable increase, and in the 15 to 19 year group, a very decided increase of deaths from this cause. In view of the fact that 96 per cent of our school children have badly decayed teeth, some of which have been a source of infection for a period of five or six years, or more, it is reasonable to suppose that dental defects may be responsible for some of the increase in our death rate from heart disease.

The same argument may hold good in the case of tuberculosis. While it has never been proved that diseased teeth are the direct cause of tuberculosis, it is interesting to note that the death rate from tuberculosis is highest in the young adult age group. The fact that these individuals have carried decayed and abscessed teeth in their mouths for a period of eight or ten years may be a predisposing factor. Undoubtedly, the presence of diseased teeth lowers resistance and affords the tubercle bacillus a surer entrance. One of the first services performed for patients in all of the better class tuberculosis sanitariums is to eliminate all dental infection as an aid to increasing their resistance.

The literature relative to focal infection is voluminous. To summarize reports from the field of ophthalmology, otology and rhinology would require a volume of no mean proportions. We all know of instances in which oral infection has been the direct cause of serious eye disorders.

C. A. Veasey[1] recites a case of a young man suffering from a severe case of iritis. Not until seven abscessed teeth were removed did he recover his eyesight.

During the past two months, a member of the Chicago Dental Society, by extracting several badly abscessed teeth for a woman, returned to her left eye the vision which had been lost for twelve years.

I never speak of diseased teeth and eye infections but that I recall a case of a little girl, 7 years old, who had lost her sight two years prior to coming to the physician. She was able to distinguish between light and dark, but not to discern

1. Veasey, C. A.: Northwest M. J., 29:263 (June) 1930.

objects. A thorough investigation revealed several abscessed teeth, which is quite unusual in a child so young. The teeth were extracted, and the bacteria found in the abscesses were grown on culture mediums. An emulsion was made of them and injected into rabbits. Within a few days, most of the rabbits developed the same type of blindness from which the little girl was suffering. The rabbits were then chloroformed, and the bacteria found in their eyes were grown on culture mediums. On microscopic examination, the germs were found to be exactly the same as those found in the little girl's teeth. With the cause removed, the child recovered her sight.

What is the economic loss from such disorders to the community? None but the most optimistic could answer that question, and their answers would not be correct.

Some ear infections can be traced to oral infections which respond to the removal of the cause in a very satisfactory manner. While deafness perhaps does not affect the individual or the community as seriously as blindness, it must be considered from an economic standpoint.

In considering the infections found in nasal passages and associated parts, we need only call attention to the infected bicuspids and molars which may be responsible for a stubborn maxillary sinuitis. It is estimated that the incidence of antrum infection from teeth is about 20 per cent.

As an economic factor in our community welfare, we must not overlook the very important fact that there is a direct relationship between dental foci of infection and abortion. One of the three great causes of death in pregnancy and labor is toxemia and eclampsia. The experience of many able obstetricians of late years has shown that the incidence of these toxic states can be greatly decreased by the elimination of focal infections. The woman who harbors infection is more likely to have toxemia and is more likely to abort by reason of changes in the placenta due to blood-borne infections. The obstetrician in my private clinic has found that the routine check for oral infections and their elimination have lessened the incidence of complications to mother and child. We insist that prenatal care shall include elimination of all foci of infection.

I have mentioned but a few systemic diseases which are sometimes caused by dental infections and which affect our economic status to such a great degree. Many times, dental infection, instead of producing definite metastatic lesions, will result in a general state of chronic invalidism. The sequelae of any primary focus of infection depend on the virulence of the infection and the resistance of the patient. Some individuals are capable of resisting what is apparently an overwhelming load of infection. Others readily manifest symptoms of secondary lesions from apparently trivial primary infections. Thus, a dental infection may be the dominant etiologic factor in any one of a large group of systemic diseases which may develop insidiously and progress slowly. I have in mind such diseases as headache, malnutrition, anemia, loss of weight, general lassitude, febrile attacks, neuromuscular and articular pains and mental depression, all of which seriously affect our daily production and wealth.

Again referring to the work in my private clinic: I will not permit the path of least resistance, diagnosis of neurasthenia or nervous exhaustion, as well as those conditions obviously due to focal infections, to be taken, but insist on a thorough search for foci.

It is also true that dental defects are many times the cause of mental depression and disorder, and that mental depression greatly affects the economics of a community is likewise true.

Each person has his own way of reacting to stress, whether of external or of internal origin. Persons of a high strung, sensitive or emotional nature are most likely to suffer mental disorders when the circulation becomes vitiated by some septic protein poison. We all tend to break down along the line of least resistance; the more sensitive the nervous system, the more readily is it affected. Thus, a man may suddenly become confused in mind as a result of pus in any region of the body. The antrum is one of the most common places, and, as I have stated, it is estimated that 20 per cent of antrum cases are caused by infected teeth. This localized pus may cause no physical change in the patient, but it may cause profound mental retardation.

As further evidence of the economic value of good dental health, I wish to quote from the statistics of the Metropolitan Life Insurance Company. The physical records of 1,000 employes with good mouth conditions and 1,000 employes with poor mouth conditions were picked at random from their files. The case data are compared in the accompanying table:

LIFE INSURANCE STATISTICS

	Good Mouth Conditions	Bad Mouth Conditions
Neuralgia and neuritis	3.8	8.3
Headache	1.9	3.2
Nervousness	1.7	4.5
Colds	19.8	23.8
Furuncles	2.4	4.5
Abscesses	2.6	4.5
Albuminuria	0.9	3.3

It is quite apparent from this tabulation that there is a definite relation between many forms of ill health and poor dental hygiene.

One of our large Chicago industrial plants further emphasizes the economic value of good health in a report issued recently. Briefly, of 185 patients having focal dental infections, seeking relief from various systemic ailments, 152, or 82.2 per cent, were cured or relieved by removal of dental infections. The general health was improved in 138, or 74.8 per cent. Of thirty-six patients having myositis, nineteen were cured, seven relieved and ten unrelieved; of 50 having arthritis, twenty-eight were cured, sixteen relieved and six unrelieved; of 43 having neuritis, twenty-five were cured, twelve relieved and six unrelieved, and of 19 having chronic stomach trouble, eight were cured, five were relieved and six were unrelieved. As the number of cases covered by this report is small, it may be that no general conclusions should be drawn from them. The percentage of cases cured or relieved is so high that I cannot but regard it as testimony in favor of the economic value of dental health.

This economic value can be no better emphasized than in the beneficial effect which it has had on the number of retarded pupils in our schools.

Frank S. Boyer, a physician of Allentown, Pa., states that a decrease of 30 per cent in the number of repeaters in the first six grades was effected in five years as a result of an intensive mouth hygiene program.

Mr. Willis Sutton, superintendent of schools of Atlanta, Ga., and president of the National Educational Association, states that after six years of intensive dental and health education in the Atlanta schools, the average percentage of repeaters dropped from 12.9 to 5.5. In

other words, they reduced their retardation by a little over one-half. Mr. Sutton estimates conservatively that his school dental program has saved the taxpayers between $200,000 and $250,000 a year. The saving to the individual child in better work, increased efficiency and more rapid transition from grade to grade can never be estimated.

Let us apply these figures to our own city of Chicago. We have approximately 600,000 children in our city schools, 8 per cent of whom are repeaters annually, a remarkably low figure.

The board of education's budget for 1931 is $96,000,000 in round numbers. Thus, it costs approximately $160 a year to educate a child. If we could effect a saving of 50 per cent in our repeaters, similar to that obtained in Atlanta, we could save our taxpayers $3,840,000 per year.

I cannot close without again referring to the mental and psychologic effect of dental deformities. It is common knowledge that one individual does not come into intimate contact with another without forming some opinion or experiencing some psychologic reaction occasioned by his observation of the other person. This judgment affects the conduct of the observer toward the observed. The conduct of the former alters the latter's estimation of himself. Thus, the possession of certain physical characteristics by an individual, through its reflection in the psychologic reaction of others, may affect his own personality. In other words, a person suffering from an exaggerated type of malocclusion often is the victim of psychogenetic influence, exerted on his character and personality through the impressions suggested to his mind by the knowledge that he possesses a deformity similar to those facial characteristics which are supposed to be an index to his character. For example, one suffering from malocclusion resulting in a noticeably receding chin is conscious that those with whom he comes in contact will naturally assume that, because he has what is commonly supposed to be a characterless jaw, he has a characterless personality. In time, this constant suggestion reacts on his mind until he does lose the decision and poise that rightfully belong to him.

There is no doubt that the physical contours of the face do affect the opinion and the judgment of others, and that the reflection of these judgments has a psychologic effect on the individual. Whether this judgment is a true one or not does not matter—it is common judgment and, as such, it affects all of us. The "Andy Gump" features may mean nothing to the psychologist, but they do influence not only the observer but also the observed. Who would deny that a good set of teeth is a source of pride, happiness and attractiveness—even economic value, to an otherwise good-looking young lady; and the reverse, to even a greater degree, if she does not have them.

Nor is the receding chin the only offender in this respect. Lloyd S. Lourie cites as an example a young man suffering from a pronounced prognathism and heavy lower lip. He was so conscious of the deformity that he seriously contemplated suicide. Obviously, a person in that frame of mind is of no value to himself or his community. Several months of orthodontic treatment corrected the deformity and removed the mental hazard. Today, he is a salesman of high caliber, a producer and an addition to his community. We could determine the economic value of his dental health to his community, but there are thousands suf-

fering from the same disorders whose economic status cannot be estimated.

That malocclusion directly affects the economic value of a community is no better exemplified than by the fact that the employment manager of one of our large mercantile institutions will not place a girl with a pronounced facial deformity in certain positions. Thus, the physically and mentally attractive applicant is given the better position, while the other is placed in the background.

In studying a group of several hundred pictures of orthodontic patients, the most noticeable improvement observed is the expression in and about the eyes. Dull listlessness gives way to vivacity and life. Obviously, the detrimental effect that bad mouth conditions have on the mental behavior of the individual by causing inferiority complexes, which interfere with the individual's progress in social, professional and business life, is enormous.

CONCLUSION

I wish to emphasize that disease is one of the big factors in the economic status of any community; for once a person has suffered from disease, he remains forever scarred by it. Much of the physical fitness, mental happiness and material progress of our citizens depends in a degree on dental health. The material wealth of any community depends largely on the general health of its citizens. Dental health is an integral part of general health. Through its influence on our physical and our mental capabilities, it directly and indirectly plays a most important part in our economic structure.

CURRENT LITERATURE

EXTRACTS AND ABSTRACTS

The Middle Ground Between Dentistry and Medicine: In an article by Goodman A. Miller (*Economics,* February, 1931), the author begins with the significant statement that "modern dentistry is human enough to be proud, but sane enough to be contrite." Dentistry is contrite because it knows so little in common with medicine. Both professions need development, because they are interdependent. The goal of each is good health, and this can be gained only through cooperation. It is just becoming apparent to the medical profession that the human animal has a soul, and to the theologians that he has a body. Medicine and dentistry should recognize the influence of each other's fields, and what they both need is a more pertinent quest of fact along all lines associated with their respective sciences, such as physiology, chemistry, anatomy and histology, all tending toward the goal of diagnosis. A basic fact to be remembered is that any pathologic process does not operate under one law in the oral cavity and under another elsewhere. A neglected mouth is a menace to the entire organism, through the medium of the circulation. In this "no man's land" between medicine and dentistry, the practitioner is called a minor oral surgeon. As the author says, "Heaven only knows what there is minor about it." The responsibilities are major, even if the reputation is minor. Take, for instance, a general arthritic condition. Too frequently, it is attributed solely to focal infection, and teeth are sacrificed without logical reasoning. Too often has the dentist failed to go with sufficient thoroughness into his cases to make certain that when the term "a clean bill of oral health" is used, it means just that. There has been too much side-stepping on the part of both professions. Each needs consultation with the other. "There is glory and grief enough for both," and they should meet on common territory for the general welfare of all. This middle ground, this no man's land, needs a higher cultivation than it has had, and all should work together in mutual confidence for the ultimate goal of good health.

Radical Operations for Major Trigeminal Neuralgia: Experiences based on 654 major operations for the relief of major trigeminal neuralgia are reported by Charles H. Frazier (*J. A. M. A.*, March 21, 1931). Excision of the gasserian ganglion is practiced with two modifications: subtotal section of the sensory root, which conserves the ophthalmic portion of the sensory root and thus eliminates danger of trophic keratitis, and conservation of the motor root, which results in preservation of the power of mastication, betters the cosmetic result and permits performance of the radical operation on both sides, should this be necessary. As for the risk attached to this technic, there has been but one fatality in the last series of 377 cases, which is considered as all that could be hoped for when one is dealing with so many patients that have passed the age of 60. The operation, perfectly performed, affords permanent relief. As for cosmetic results, the scar is invisible. In two cases in 100, a transitory facial paresis, slow in developing, and slow but sure to disappear, was experienced. Avoidance of injury to the petrosal nerve eliminates danger of this paralysis. Since modification of the technic to conserve the ophthalmic portion of the sensory root, keratitis is no longer to be feared. There is, the author states, unanimity of opinion that the cerebellar approach, if accepted generally as a substitute for the temporal route, would inevitably be attended with a decidedly higher mortality. The radical operation should, he believes, never be approached with any sense of assurance that there will be no technical difficulties, because there is the greatest variation between one case and another anatomically. The patient requires no special postoperative care, usually being out of bed on the fifth day and ready to leave the hospital on the seventh.

MISCELLANY

BOOK REVIEW

Dental Roentgenology. By LeRoy M. Ennis, D.D.S., Assistant Professor of Roentgenology in the Thomas W. Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania; Instructor in Dental Roentgenology, in the Graduate School of Medicine, University of Pennsylvania; Captain Dental Reserve Corps, United States Army. Illustrated with 582 engravings. 288 pages. Price $6.50 net. Published by Lea & Febiger, Philadelphia.

The growing significance of the roentgen ray, its value and its limitations, all combine to render its study of ever-increasing importance. Since Roentgen first discovered the rays that bear his name, in 1895, there has been a constant evolution of thought on the subject, and many papers, treatises and larger volumes have been produced for the enlightenment of the professions.

Dr. Ennis has added much to the knowledge of the subject in his book, and, more than that, he has taken the knowledge already produced and formulated and systematized it to make it of greater service to the profession. For instance, in his chapter dealing with anatomic landmarks, he has pointed out the possibility of much mistaken diagnosis through interpreting normal foramina, sinuses, etc., as evidence of pathologic processes. Many mistakes of this character have been made, and the profession will do well to study this phase of the subject with great care. The author might have given a more extended consideration than he has to the subject of interpretation. He might have emphasized the fact that there has been too great a tendency to jump at conclusions regarding the significance of rarefied areas around root ends, since it has been too much the custom to call every area of this nature an "abscess" or a "pus pocket," without any other evidence than the shadow. Greater conservatism is needed to the end that less harm shall be done.

An interesting illustration is the one in the introduction (Fig. 1) showing the first dental roentgenogram ever made, fourteen days after Roentgen discovered the process. This demonstration must have seemed almost miraculous to the profession of that day, and yet it is less than forty years since the first roentgenogram was taken. In that time, great strides have been made in its development, each new advance placing humanity under deeper obligation to the men who are continually studying this science. Dr. Ennis has

made a valuable contribution to the literature of the subject and the profession is greatly indebted to him.

One slight question must be raised in connection with the terms "premolar" and "canine." It is not the place here to go fully into the propriety of these terms, except to say that to name a human tooth after a dog when the simple term cuspid is perfectly appropriate and fully as euphonious seems incongruous and far-fetched; while as far as the term premolar is concerned, it is positively a misnomer. A biscuspid is not logically a premolar either in period of eruption or in position in the arch.

This is not intended as any reflection on the present volume which it is a pleasure to commend in the highest terms.

Books and Pamphlets Received

The Calcutta Dental College and Hospital. Founded 1920. Tenth Annual Report 1930-1931 Calcutta, India.

This is the only organized dental training institution in India, and there are sixty-seven students at present on the rolls. Altogether, there have gone out from this institution 103 students. The president is B. C. Roy, and the principal, R. Ahmed. They have a faculty of eighteen, and it is evident that excellent work is being done in educating the dentists of India.

Estudios Sobre el Fluor y la Fluorosis Experimental. Por el Dr. Juan Chancles, Buenos Aires, 1930.

CORRESPONDENCE

Are Crowned Teeth a Menace?

To the Editor:

I have so frequently seen the statement that all crowned teeth are a menace to health that I have felt a determination to set all who read right on this one phase of pathology.

Is it not the treatment of root canals that should be under suspicion? A crown or a filling has its bearing on the soft tissues surrounding the tooth, and all root-end infections are caused by faulty root-canal therapy. A beautiful crown, the construction of a genius, could not prevent root-end infection, caused by faulty root-canal treatment, and, finally, the pressure of an artificial crown has absolutely no bearing on apical infection.

Thomas E. Gilmore, D. D. S.

"What Factors Determine the Early Stage of Paradentosis (Pyorrhea)?"

To the Editor:

Several months ago (The Journal, October, 1930, pp. 1889-1907) I discussed Becks' statements concerning the significance of the location of the bottom of the crevice on the cemento-enamel junction. (The Journal, December, 1929, pp. 2167-2188.) At that time, I stated (and showed by histologic findings) what we actually find in our microscopic material. At the same time, I denied that the position of the bottom of the pocket at the cemento-enamel junction has any particular significance as a "landmark" or "borderline" in the process of detachment of the epithelial attachment from the tooth surface; and I criticized one of Becks' specimens shown in his first publication on this subject. I wish to state that I still voice this criticism and that Becks' recent publication did not present any evidence to change my opinion. Only actual findings and not mere statements add knowledge to a subject. Becks' illustration referred to has the following description (p. 2179, Fig. 11): "Pocket on the cemento-enamel junction (*CE*), in a monkey." Those familiar with the subject will recognize that the pocket is not at the cemento-enamel junction but on the enamel surface. In my paper on this subject, I asked for proofs of Becks' argument; yet in his recent publication, he does not consider it essential "to add another confirmatory picture," although I had already called his attention to the fact that in the only picture he did show, the bottom of the crevice was not at the point where he claimed it was.

Rudolf Kronfeld, Chicago.

An Appeal

The editor of "Who's Who in Dentistry" is anxious to improve his work in a forthcoming edition, and to this end he appeals to the outstanding men in the profession to furnish reliable data when requested. A work of this kind is of value only when authentic information is obtained, and this can come almost solely through the subjects of the sketches themselves. A book like this is valuable for reference and should be encouraged. Write Dr. Samuel Greif, 220 New Lots Avenue, Brooklyn, N. Y.

NEWS

Dr. Toro Sent to U. S. by Chilean Government: Rafael Toro K., dean of the department of crown and bridge work of the dental college of the University of Santiago, Chile,

Dr. Rafael Toro K., Santiago, Chile

dean of the Dentist's Hospital and founder of the dental policlinic handling social diseases of the mouth, in Chile, has returned home after spending nearly a year in the United States studying new methods in dentistry. He was sent here by his government, and spent several months in study at the University of California, where he was the recipient of the degree of master of science.

Deaths

Grunn, Albert P., Chicago, Ill.; Northwestern University Dental School, 1900; died suddenly, of heart failure, May 12, while on a vacation at Excelsior Springs, Mo.; aged 54.

Hardy, George E., Baltimore, Md.; Baltimore College of Dental Surgery, 1888; died, May 17.

Hopewell Smith, Arthur, Beckenham, England; Charing Cross Hospital and Royal Dental Hospital, London; died March 4; aged 65.

Inglis, Otto E., Swarthmore, Pa.; Philadelphia Dental College, 1886; died February 5; aged 67.

Young, J. Lowe, New York City; Philadelphia Dental College, 1890; died recently.

ASSOCIATION NEWS

More About Your New Home

Now that the move has been made and the American Dental Association is occupying a home of its own, the invitation is again extended to drop in and look it over. That we may be better acquainted right away it seems desirable to present the following information relative to the locations that have been worked out.

First floor:
- Information
- Business Manager
- Cashier
- Library
- Storeroom
- Addressograph

Second floor:
- Secretary
- Board of Trustees Room
- Editorial Department

Third floor:
- Bureau of Dental Health Education
- Advertising
- Committee on Study of Dental Practice

Fourth floor:
- Council on Dental Therapeutics
- Bureau of Chemistry

The Memphis Meeting

The Local Arrangements Committee at Memphis are going forward with plans for the Annual Session to be held October 19-23. They are determined to make this the best meeting that has been held and already the reservations are coming in at a fine rate. Every member should avail himself of the opportunity of taking advantage of this fine postgraduate course given by the foremost men in dentistry. Send in your reservations early.

A. D. A. Group Insurance

Eight claims were paid during April, making a total of seventy-six claims paid to April 30, or an aggregate amount of $191,800.

ANNOUNCEMENTS*

CALENDAR OF MEETINGS

American Dental Association, Memphis, Tenn., Oct. 19-23, 1931.

American Dental Hygienists' Association, Memphis, Tenn., Oct. 19-23, 1931.

American Dental Assistants Association, Memphis, Tenn., Oct. 19-23, 1931.

American Dental Society of Europe, Paris, France, July 29-August 1, 1931.

American Society of Oral Surgeons and Exodontists, Memphis, Tenn., Oct. 16-17, 1931.

International Dental Congress, Paris, France, Aug. 3-8, 1931.

International Orthodontic Congress, London, July 20-24, 1931.

International Stomatologic Congress, Budapest, Sept. 2-7, 1931.

National Association of Dental Examiners, Memphis, Tenn., October 17.

Committee on Costs of Medical Care, Washington, D. C., September 17-24.

Greater New York, New York City, November 30-December 4.

Montreal Dental Club, October 15-17.

Northern Ohio Dental Association, Cleveland, June 1-4.

Society for Advancement of General Anesthesia in Dentistry, New York City, third Monday in February, April, October and December.

Southwestern Dental Society, Albuquerque, N. M., October 13-15.

Upper Peninsula Dental Society, Iron River, Mich., June 25-27.

STATE SOCIETIES

District of Columbia, at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June, inclusive.

June

Arkansas, at Little Rock (1-3).
California Southern, at Los Angeles (8-13).
Georgia, at Atlanta (10-12).
Maine, at South Poland (18-20).
Mississippi, at Gulfport (4-6).
Nevada, at Reno (6).
Oregon, at Portland (17-20).
Washington, at Bellingham (June 30-July 1).
Wisconsin, at Milwaukee (9-11).
Wyoming, at Sheridan (22-23).

October

New Mexico, at Albuquerque (13-15).

December

Ohio, at Cincinnati (1-3).

MEETINGS OF STATE BOARDS OF DENTAL EXAMINERS

Alabama, at Birmingham, June 22. E. W. Patton, Secretary, 1807 Comer Bldg., Birmingham.

Arkansas, at Little Rock, June 22-25. Clarence W. Koch, Secretary, 817 Donaghey Bldg., Little Rock.

Colorado, at Denver, June 2-6. Z. T. Roberts, Secretary, 810 Metropolitan Bldg., Denver.

Connecticut, at Hartford, June 24-27, A. J. Cutting, Recorder, Southington.

Delaware, at Wilmington, June 17-18. W. S. P. Combs, Secretary, Middletown.

Florida, at Jacksonville, June 18-20. R. P. Taylor, Secretary, Jacksonville.

Indiana, at Indianapolis, June 15. J. M. Hale, Secretary, Mt. Vernon.

Kansas, at Wichita, June 15-20. John L. Parkhurst, Secretary, Iola.

Kentucky, at Louisville, June 5-10. Robert L. Sprau, Secretary, 970 Baxter Ave., Louisville.

Maine, at Augusta, June 22-24. Alton H. Swett, Secretary, 192 State St., Portland.

Massachusetts, at Boston, June 10-13. W. Henry Grant, Secretary, State House, Boston.

Minnesota, at Minneapolis, June 12-20. Walter H. Smith, Secretary, 2337 Central Ave., Minneapolis.

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*Announcements must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

Mississippi, at Jackson, June 16. T. Ford Leggett, Secretary, Laurel.

Missouri, at St. Louis, June 10-13, George E. Haigh, Secretary, Central Trust Bldg., Jefferson City.

Montana, at Helena, July 14-18. T. P. Regan, Secretary, Helena.

Nebraska, at Omaha (June 15-17) and Lincoln (June 18-20). Mrs. Clark Perkins, Director, Bureau of Examining Boards, Dept. of Public Welfare, Lincoln.

New Jersey, at Trenton, June 29-July 4. John C. Forsyth, Secretary, 148 W. State St., Trenton.

North Dakota, at Fargo, July 14-17. Larry B. McLain, Jamestown.

Pennsylvania, at Philadelphia and Pittsburgh, June 18-22. W. A. McCready, Secretary, 115 Highland Bldg., Pittsburgh.

Rhode Island, at Providence, June 23-25. Albert L. Midgley, Secretary, 1108 Union Trust Bldg., Providence.

South Carolina, at Greenville, June 23-25. W. H. Sherard, Secretary, Anderson.

South Dakota, Sioux Falls, June 25-27. John J. Berry, Secretary, Deadwood.

Tennessee, at Memphis, June 8. F. W. Meacham, Secretary, Hamilton National Bank Bldg., Chattanooga.

Utah, at Salt Lake City, June 29-July 3. S.S. Burnham, Secretary, Ezra Thompson Bldg., Salt Lake City.

Vermont, at Montpelier, June 29-July 1. H. B. Small, Secretary, Burlington.

Virginia, at Richmond, June 9. John M. Hughes, Secretary, Medical Arts Building, Richmond.

Wisconsin, at Milwaukee, June 15-19. S. F. Donovan, Secretary, Tomah.

Wyoming, at Cheyenne, June 27-30. F. A. Wilson, Secretary, Hynds Bldg., Cheyenne.

MISSOURI BOARD OF DENTAL EXAMINERS

The next examination of applicants to practice dentistry in Missouri will be held at the Washington University Dental College, St. Louis, June 10-13. Applications must be filed with the secretary at least five days before the date of examination. For further information address

GEORGE E. HAIGH, *Secretary,*
Central Trust Bldg.,
Jefferson City.

GREATER NEW YORK DECEMBER MEETING

The seventh annual Greater New York December Meeting will be held at the Hotel Pennsylvania, New York City, November 30-December 4. An invitation has been accepted by the Chicago Dental Society to supply essayists and clinicians for the entire meeting. There will be a joint meeting of the five county medical societies of Greater New York and the first and second district dental societies. A manufacturers' exhibit will be held in the hotel simultaneously with this meeting.

KANSAS STATE BOARD OF DENTAL EXAMINERS

The Kansas State Board of Dental Examiners will meet, June 15-20, at the Lassen Hotel, Wichita.

JOHN L. PARKHURST, *Secretary,*
Iola.

UTAH BOARD OF DENTAL EXAMINERS

The next meeting of the Utah Board of Dental Examiners will be held, June 29-July 3, at Salt Lake City.

S. S. BURNHAM, *Secretary,*
Ezra Thompson Bldg.,
Salt Lake City.

NATIONAL ASSOCIATION OF DENTAL EXAMINERS

The National Association of Dental Examiners will meet in Memphis, Tenn., October 17.

GEORGE L. POWERS, *Secretary,*
Memphis, Tenn.

STATE OF WYOMING BOARD OF DENTAL EXAMINERS

The Board of Dental Examiners of Wyoming will meet for its regular examination in Cheyenne, June 27-30. For further information, address

F. A. WILSON, *Secretary,*
Hynds Bldg.,
Cheyenne.

SOUTHWESTERN DENTAL SOCIETY AND NEW MEXICO STATE DENTAL SOCIETY

The Southwestern Dental Society and the New Mexico State Dental Society will hold a

joint annual meeting in Albuquerque, October 13-15.

FRED MULLER, *Sec'y-Treas.*,
N. M. State Dental Society,
Taos.

FLORIDA STATE BOARD OF DENTAL EXAMINERS

The Florida State Board of Dental Examiners will hold its annual examination, June 18-20, at Jacksonville, to examine applicants for license to practice dentistry and dental hygiene. All applications, accompanied by photograph and examination fee, must be in the hands of the secretary at least ten days before the date of the examination. For application blanks and further information, apply to

R. P. TAYLOR, *Sec'y-Treas.*,
Jacksonville.

OHIO STATE DENTAL SOCIETY

The sixty-sixth annual meeting of the Ohio State Dental Society will be held at the Netherland Plaza Hotel, Cincinnati, December 1-3. The Southern Society of Orthodontists will hold its meeting in Cincinnati on the same dates.

E. C. MILLS, *Secretary*,
255 East Broad St.,
Columbus.

MONTREAL DENTAL CLUB

The Montreal Dental Club will hold its seventh annual fall clinic in the Windsor Hotel, October 15-17, in conjunction with the McGill University graduates' reunion, which opens October 14.

E. C. BURBANK, *Chairman of Publicity*,
1008 Medical Arts Bldg.,
Montreal.

NORTH DAKOTA STATE BOARD OF DENTAL EXAMINERS

The North Dakota State Board of Dental Examiners will hold its next meeting, July 14-17, in the Gardner Hotel, Fargo. Applications should be in the hands of the secretary at least ten days before the meeting.

LARRY B. MCLAIN, *Acting Secretary*,
Jamestown.

RHODE ISLAND BOARD OF REGISTRATION IN DENTISTRY

The Rhode Island Board of Registration in Dentistry will hold an examination for registration for both dentists and oral hygienists in Providence, June 23-25. Full information, application blanks, etc., may be secured at the office of the secretary. All applications must be filed at the office of the secretary at least ten days before date set for examination.

ALBERT L. MIDGLEY, *Secretary*,
1108 Union Trust Bldg.,
Providence.

THE AMERICAN DENTAL SOCIETY OF EUROPE

The annual meeting of the American Dental Society of Europe will take place, July 29-August 1, at the Hotel Majestic, Avenue Kleber, Paris, just prior to the International Dental Congress. Among those from America contributing to the program are Hugh W. MacMillan, Percy R. Howe, Paul R. Stillman, W. D. Tracy, Ferdinand G. Neurohr, R. O. Schlosser, H. S. Dunning, J. D. White, R. H. Volland, Kermit F. Knudtzon, George B. Winter, J. V. Conzett, W. A. Spring, Rupert E. Hall, H. B. Morton, S. W. Singer, J. F. Hovestadt, A. F. Jackson and Benjamin Sandy. Accommodations can be secured by application direct to the Hotel Majestic, Paris.

DAWSON BUCKLEY, *Secretary*,
25 Bd. Victor Hugo,
Nice, France.

NOTICE

April 19, 1931, the body of a woman was found in the Wapsipinicon River. Description follows: . . .

Teeth: All teeth present in good condition. The left upper third molar just erupting. The other third molars not erupted.

Bridges of Teeth: 1. Left upper—a gold crown on the first bicuspid and one on the second molar connected by a gold bridge. This bridge apparently new as it had not been worn very smooth. 2. Upper left Canine had a gold crown. 3. Lower Left—second bicuspid, and first molar missing of old extraction. 4. Upper Right—a gold crown on first molar attached to which is an artificial tooth supply the second bicuspid. 5. Lower Right—a gold crown first bicuspid and one on second molar, and connected by a gold bridge.

E. R. COOKE, *Sheriff*,
Clinton, Iowa.

PACKAGE LIBRARIES*

Compiled by and Available for Circulation

from the

LIBRARY BUREAU

of the

AMERICAN DENTAL ASSOCIATION

212 East Superior Street, Chicago, Ill.

Absorption of roots and bone.
†Agranulocytic angina.
Alveolar process—its structure, anatomy and resorption.
Alveolectomy.
Amalgam fillings and physical properties of amalgam.
†Anesthetics in children's dentistry.
Apicoectomy.
Articulation, occlusion and mandibular movements.
†Bacteriology.
Best time for orthodontic treatment.
†Blood count in focal infection.
†Bridges using inlays as abutments.
†Broken needles.
Business side of dentistry.
†Calcium metabolism.
Cancer of mouth.
Carbon dioxide administered in conjunction with nitrous oxid-oxygen anesthesia.
Cast gold inlays.
Casting gold, including inlays and dentures.
Cavity preparation.
†Cementation of inlays.
†Child psychology.
Children's dentistry.
Clasps—wire and cast.
Cleft lip and palate—etiology and surgical treatment.
†Cleft palate—orthodontic treatment and prosthetic appliances.
Community and school dental service.
Comparative dental anatomy.
Conduction anesthesia.
Condyle path movements.

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*Each package library contains information on one of the subjects listed and is composed of reprints, magazine clippings, etc., on that subject only. The packages are loaned to members of the Association for a period of one week after date of receipt. Unless the material is reserved for another borrower, an extension of time will be granted on request. The charge for borrowing a package library is 50 cents. The rental fee should accompany the request for a package library. No packages are sold. In response to requests, packages will be compiled on other subjects pertaining to dentistry.

†These packages contain less than the usual number of articles.

†Congenitally missing teeth.
†Contributions dentists have made outside their profession.
†Curetting.
Cysts and tumors of mouth.
Dental assistants.
†Dental care of the preschool child.
Dental caries.
†Dental cements.
Dental clinics.
†Dental disease and practice in the tropics
Dental economics.
†Dental erosion.
Dental ethics.
Dental hygienists.
†Dental nomenclature.
Dental health education.
Dental service in the World War.
Dentifrices.
Dentistry as a career and the status of the dentist.
Denture bases—discussion of materials.
Denture casting.
Diet and nutrition in relation to teeth.
Diet in pregnancy.
†Dry socket.
†Education of denture patients.
†Emphysema.
Endocrine glands in relation to teeth.
†Eruption of teeth—dates of eruption and accompanying symptoms.
†Eruption of teeth—theories regarding.
Esthetics in denture construction.
Ethyl chlorid.
Ethylene anesthesia.
Etiology of caries.
Etiology of malocclusion and preventive orthodontia.
†Etiology of pyorrhea and its relation to systemic conditions.
Evolution of human dentition.
Examination of the mouth and oral diagnosis.
Extraction of teeth.
First permanent molar.
Fixed and removable bridgework.
Focal infection.
Focal infection in relation to diseases of the eye.
Foreign bodies (of dental origin) in the lungs and esophagus.
Fractures of the jaws.
Full denture construction.
Gold foil.
Habits as factors in malocclusion.
†Hemophilia or excessive hemorrhage following extraction.
Hereditary influences in malocclusion.
†High frequency in dentistry.
†Histologic examinations of fractured roots.
†Histologic study of teeth and tissues.
History and progress of dentistry.
History of dentistry.
Hospital dental service.
†Hypercementosis and excementosis.

†Immediate denture service.
Impacted teeth and their removal.
Impacted third molars.
Implantation, replantation, transplantation of teeth.
Impression technic.
Indirect inlay technic.
Industrial dental service.
Influence of deciduous teeth and first permanent molars on occlusion.
†Influence of syphilis and fevers on tooth form and structure.
Interpretation of roentgenograms.
Investment compounds and technic.
Ionic medication.
Lectures to nurses.
Local anesthesia.
Local anesthesia: contraindications and untoward results.
†Ludwig's angina.
Mandibular movements.
Materia medica and therapeutics.
Maxillary sinus and antrum—diseases and treatment.
Methods of sectioning and staining teeth.
Monson's theory.
Mottled enamel.
Mouth hygiene.
Muscle exercises and training in orthodontia.
Nitrous oxid-oxygen anesthesia.
†One piece casting for bridges and partial dentures.
Oral diagnosis.
Oral diagnosis with reference to roentgen ray.
Oral manifestations of systemic conditions.
Organized dentistry.
Orthodontia and its relation to dentistry and medicine.
Orthodontic appliances.
†Orthodontic treatment of impacted cuspids.
Osteomyelitis of the jaws.
"Panel" or insurance dentistry.
Partial dentures.
†Permeability of tooth structures.
Physical therapy in dentistry.
†Pinledge and pinlay attachments.
Place of extraction in orthodontic treatment.
Plastic surgery.
Porcelain in dentistry.
Porcelain inlays.
Porcelain jacket crowns.
Postoperative complications and care.
†Postoperative psychosis.
†Pregnancy and dental disease.
Preoperative examination of patients.
†Preparation of cavities with hypersensitive dentin.
Preventive orthodontia.
Procain (novocain) dermatitis.
†Program building for state and district societies.
Prophylactic odontotomy.
Pulp conservation including pulp capping and cavity lining.
†Pulp pathology.
†Pulp stones.

Pyorrhea.
Relation between dental conditions and mental health of insane.
Relation of the dentist to the physician.
†Removable bridgework—discussing various types of attachments.
Retainers used in orthodontia.
†Retrusion of the mandible causing impaired hearing.
Root canal treatment.
†Salivary calculus.
Should dentistry be advertised?
†Status lymphaticus.
Sterilization of dental instruments.
Stomatology.
Studies of saliva.
Suggestions for talks to mothers.
†Supernumerary teeth.
Surgical treatment of pyorrhea.
Three-quarter crowns.
Tooth arrangement for full dentures.
Toothbrushes and toothbrush containers.
Toothbrushes, tooth pastes and mouth washes.
†Torus palatinus.
Traumatic occlusion.
Trigeminal neuralgia.
†Tuberculosis and dentistry.
Ultraviolet ray in the treatment of pyorrhea.
Ultraviolet ray therapy in dentistry.
Undergraduate and graduate orthodontic education.
Use of elevators in extraction.
Value of dental service in schools.
Value of roentgen-ray examinations in orthodontia.
Various studies of or pertaining to saliva.
Vincent's infection.
Wax expansion method.
†Waxes.

A list of recent books which may be borrowed from or purchased through the Library Bureau was published in the April 1931 issue of THE JOURNAL.

AMERICAN DENTAL ASSOCIATION

Memphis, Tennessee. October 19-23, 1931.

HOTEL RESERVATION

In securing hotel reservations for the 1931 Session, consult the hotel rate-sheet and fill out the blank application below. Mail immediately to the hotel you wish to patronize. The hotel will then advise you of the reservation which has been made for you.

As your first choice may not be available, kindly indicate a second and a third choice. If none of these are available, the hotel manager will mail your application to the Chairman of Halls and Hotels Committee, who will make a reservation for you in as favorable a hotel as possible.

Please remember that a reservation constitutes a contract with the hotel to provide you with the accommodations you desire. If you find it impossible to carry out your part of the contract, namely, to occupy the room at the time agreed on, please write or wire the hotel, releasing it, in order that your room may be available for other members.

MAIL THIS APPLICATION DIRECT TO THE HOTEL

HOTEL RESERVATION

AMERICAN DENTAL ASSOCIATION, MEMPHIS, TENNESSEE, OCTOBER 19-23, 1931

.....Hotel. .....1931.

Memphis, Tenn.

Please reserve sleeping room accommodations as noted below:

.....Room(s) with bath for.....people. Rate desired $..... (per day)

.....Room(s) without bath for.....people. Rate desired $..... (per day)

Second choice hotel.....

Third choice hotel.....

ROOMS TO BE OCCUPIED BY:	ADDRESS IN FULL
Applicant.....	.....
.....	.....
.....	.....

Please confirm this reservation to applicant. I further agree to notify the hotel at once in the event I am unable to use this reservation.

IMPORTANT TO HOTEL MANAGER: In the event you cannot accept this reservation, please forward this application at once to Dr. E. F. Simpson, Chairman Halls and Hotels Committee, 735 Sterick Bldg., Memphis, Tenn., who will attend to the assignment of this reservation.

HOTEL	Single Room with Bath	Double Room with Bath	Single Room without Bath	Double Room without Bath
ADLER 73 Linden Ave.	$2.00 & up	$3.50 & up 5.00 & up (twin beds)	$1.50 & up	$2.50 & up
AMBASSADOR 347 S. Main	2.00	3.50	1.50	2.50
CATHOLIC CLUB 185 Adams			1.25	2.00
CHICKASAW 99 S. Main			1.00	1.50
CHISCA 270 S. Main	2.00 & up	4.50 & up 5.00 & up (twin beds)	2.00 & up	3.50 & up
CLARIDGE 109 N. Main	3.00 & up	4.50 & up		
DESOTO 154 E. Calhoun			1.25	2.00
ELK'S 69 Jefferson	3.00-3.50	4.00-5.00 5.00-6.00 (twin beds)	2.00-2.50 Con. bath	3.00-4.00 Con. bath
FOREST PARK 855 Union	2.00	2.50	1.00-1.50	1.50-2.00
GAYOSO 139 S. Main	3.00 & up	5.00 & up	2.00 & up	3.00 & up
HERMITAGE APTS. 200 Union	1.50	2.75	1.00	1.75
WM. LEN 110 Monroe Ave.	2.50 & up	4.50 5.00 (twin beds)		
LONGINOTTI S. Main St.			1.00	1.50
PARKVIEW 1914 Poplar	3.50	5.00-6.00		
PEABODY HOTEL 149 Union	3.50 & up	5.50 & up 7.00 & up (twin beds)		
PLAZA 214 Calhoun	2.00	3.00	1.50-2.00	2.50-3.00
POLK APTS. 630 Madison	2.00	2.50-3.00		
PONTOTOC 69 Pontotoc	1.50	2.00	1.00	1.50
TENNESSEE 80 S. Third St.	2.00 & up	3.00 & up		
WINONA 110 E. Calhoun	2.00	3.00	1.00-1.50	2.00-3.00
WALDORF S. Main St.	1.50	2.00	1.00	1.50

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1930-1931

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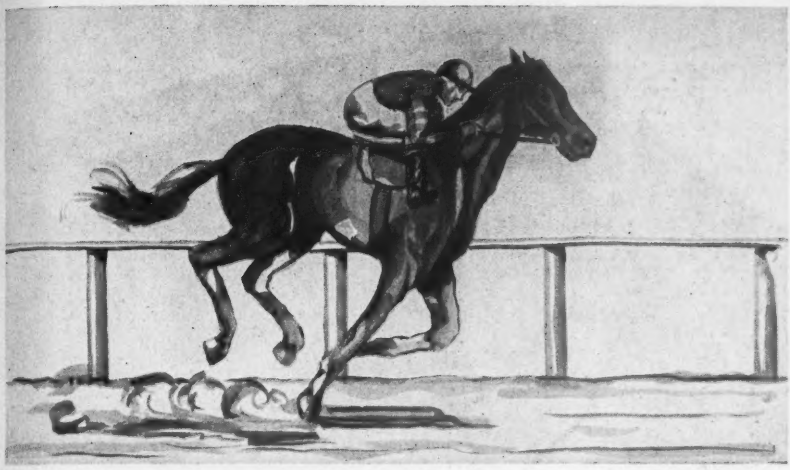

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